Vol. 11, No. 4
February 28, 1986

Energy Research Abstracts

Abstracts 6886-8166

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Office of Scientific and Technical Information; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $72.00 for domestic (North America) or $90.00 for foreign (outside North America) subscribers; a single issue is $5.00 or $6.25, respectively.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

DOE Patents Available for Licensing (PAL)

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available (use PB86-946800) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual price is $18.00 for domestic (North America) or $36.00 for foreign (outside North America); a single issue is $9.00 or $18.00, respectively.

Energy Meetings (EM)

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB86-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $45.00 for domestic subscribers and $90.00 for subscribers outside the North American continent; a single issue is $5.00 and $10.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription price (12 issues plus cumulative index) is $85.00 for domestic (North America) and $170.00 for foreign (outside North America) subscribers; a single issue is $8.00 and $16.00, respectively.

***Current Energy Patents (CEP)*–PB86-902800.** International patent literature, including patent applications, on any aspect of energy production, conservation, and utilization.

***Energy and the Environment (EAE)*–PB86-914900.** Impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

***Fossil Energy Update (FEU)*–PB86-914600.** The exploration, development, processing, and use of fossil fuels.

***Fusion Energy Update (CFU)*–PB86-915300.** Information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

***Solar Energy Update (SEU)*–PB86-914500.** The utilization of solar energy, including biomass and tidal and wind power.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $45.00 for domestic (North America) and $90.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB86-901000.** Acid precipitation, including effects and possible control measures.

***Buildings Energy Conservation (BEC)*–PB86-900700.** Technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)*–PB86-901400.** Conversion of coal into gaseous or liquid fuels.

***Coal Combustion and Utilization (CCU)*–PB86-914400.** Coal combustion, including fluidized bed combustion, and direct utilization of coal for power generation, fuel cells, and MHD generators.

***Coal Preparation and Pollution Control (CPC)*–PB86-900800.** Coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB86-946600.** Photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB86-900600.** Biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB86-914700.** Exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*–PB86-900500.** Heavy-ion (A > 4) reactions.

***Laser Research (LAR)*–PB86-901100.** Laser research and development, excluding applications.

***Nuclear Fuel Cycle (NFC)*–PB86-913400.** Both front and back ends of the nuclear fuel cycle.

***Nuclear Reactor Safety (NRS)*–PB86-913500.** Accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB86-902900.** Management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB86-901200.** Research and development of efficient and reliable solar thermal conversion systems.

***Transportation Energy Research (TER)*–PB86-900900.** Energy-efficient advanced automotive propulsion systems and transportation energy conservation.

***Unconventional Petroleum (UCP)*–PB86-901300.** Secondary and tertiary recovery of petroleum and oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information on the conversion of biomass to energy. *Biomass Abstracts* is available free to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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Vol. 11, No. 4
ISSN: 0160-3604
CODEN: ERABD
February 28, 1986

ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, OSTI builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to OSTI's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of OSTI's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Office of Scientific and Technical Information has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications; OSTI also serves as adviser for special publication needs of the Department. To effectively manage DOE's technical information resources, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

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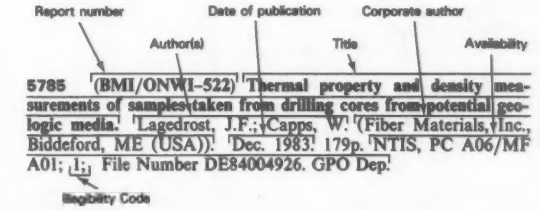
United States Department of Energy, P. O. Box 62, Oak Ridge, TN 37831

HOW TO USE *ENERGY RESEARCH ABSTRACTS*

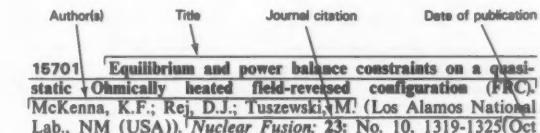
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Author(s)
Date of publication
Corporate author
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.
Eligibility Code

Abstract

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).

Abstract

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522	**9:5785**	**NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70**

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Foreign Sources

CEA Centre d'Etudes de Saclay
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Fachinformationszentrum
Energie, Physik, Mathematik GmbH
Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
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IEA Coal Research
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Springfield, VA

National Institutes of Health
National Library of Medicine
Bethesda, MD

Plenum Publishing Corporation
New York, NY

University of Tennessee
Graduate School of Library and Information Sciences
Knoxville, TN

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 39 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semi-monthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

6886 **(CONF-850297—) Second USAID/GOI workshop on alternative energy resources and development: coal conversion and biomass conversion.** (Viking Energy Corp., Pittsburgh, PA (USA)). 1985. Contract AC22-83PC60408. 430p. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

The intent of the Workshop was to review the progress of the program during the past year; to encourage US specialists to discuss with their Indian counterparts the direction and future of the program; to assess the status of the individual projects through site visits to the facilities and address any concerns or anticipated problems in meeting the objectives of each of the collaborative projects; and to provide a forum for technical exchange between US and Indian industry to understand the need for an availability of technology, products and services in the US and India in specific areas of interest in coal and biomass conversion. Separate abstracts were prepared for 17 papers for inclusion in the Energy Data Base.

0104 PROCESSING

REFER ALSO TO CITATION(S) 6911, 6911, 6912, 6913, 6918, 6925, 6925, 6926, 6934, 7497, 7497

6887 **(BMFT-FB-T—85-080) Planning of a coal gasification plant using the circulating atmospheric fluid system.** Wargalla, G.; Daradimos, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1985. 148p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE86750487.

Gasification of ballast coal and high-grade coal was tested in a pilot plant with a capacity of 1,5 MW thermal using the circulating fluid bed process. The test results were the basis of a project study for the design and construction of an industrial scale gasification unit with an out-put of 34000 Nm^3/h combustible gas, i.e. 293 Gj/h. The gas generated will substitute fuel and natural gas. The tailings of the gasification plant and of its gas purification equipment are to be used in an existing circulating fluid bed combustion unit. Taking into account the actual energy price situation the study shows this project not to be viable.

6888 **(CONF-850201—1) Coal gasification - an engineering challenge.** Seidl, R.M. (Allis-Chalmers Coal Gas Corp., Milwaukee, WI (USA)). 1985. Contract FC21-85MC22146. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003817.

From ASME energy-sources technology conference and exhibition; Dallas, TX, USA (17 Feb 1985).

Allis-Chalmers Corporation began development of the KILnGAS coal gasification technology in 1971. This technology is currently being demonstrated by the KILnGAS Commercial Module, located on the site of the Illinois Power Company's Wood River Generating Station in East Alton, Illinois. The unit is specifically designed to convert high-sulfur bituminous and sub-bituminous coals into environmentally-suitable, low-Btu gaseous fuel for firing large boilers and combustion turbines. Although this technology is based on more than 20 years experience with rotary kilns in the minerals processing industry, the unique application of coal gasification in a pressurized rotary vessel required extensive engineering development efforts in the areas of coal feed, end seals, air and steam porting, and gasifier communications, to name but a few. In addition to describing the KILnGAS process, this paper discusses various engineering challenges and their associated solutions. The paper also describes the KILnGAS Commercial Module and the operating experience and test results to date, especially regarding major engineering accomplishments. 4 refs., figs.

6889 (CONF-850297—, pp 189-201) **Hot gas cleanup: BHEL's programme on granular bed filter (GBF).** Rao, S.R.; Rangan, R.S. (Bharat Heavy Electricals Ltd., Hyderabad, India). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

Granular bed filters have been identified as having potential for cleaning gases in hot conditions. The test rig is being designed using a fluidized-bed combustor operating at 5 atm and 900°C, as the required dusty gas generator. The test facility and the granular bed filter unit are described. The dirty gas and clean gas regions are separated by a horizontal plate. For initial studies, 2 mm dia alumina balls are selected as filter media. The face velocity of the gas will vary from 0.23 to 0.76 m/sec. (DMC)

6890 **(CONF-850602—1) KILnGAS system for coal gasification.** Petersen, G.T.; Hilt, M.B. (Allis-Chalmers Coal Gas Corp., Milwaukee, WI (USA); General Electric Co., Fairfield, CT (USA)). 1985. Contract FC21-85MC22146. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003819.

From 16. international congress on combustion engines; Oslo, Norway (3 Jun 1985).

Allis-Chalmers is currently demonstrating a new coal gasification technology, called the KILnGAS process, at East Alton, Illinois, USA. Concurrently, the General Electric Company has conducted design and development to support the application of the KILnGAS process to future Integrated Gasification Combined-Cycle systems. This paper summarizes the status of the gasification technology, reports the results of General Electric Company's work in applying the gasification technology to their gas turbine combustor, and discusses the future of KILnGAS Integrated Gasification Combined-Cycle systems. 14 figs.

6891 **(CONF-851027—4) Upgrading coal-derived liquids for toxicity mitigation. I. Evaluation of non-hydrotreatment processes as alternates or supplements to hydrotreatment.** Ho, C.H.; Jones, A.R.; Smith, L.H.; Epler, J.L.; Griest, W.H.; Guerin, M.R. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003309.

From Health and environmental research on complex organic mixtures; Richland, WA, USA (21 Oct 1985).

Seven non-hydrotreatment processes related to petroleum refining practices have been evaluated at the laboratory scale as alternates to hydrotreatment in the toxicity mitigation of several coal-derived liquids. These treatments were distillation, acid treatment, alkaline treatment, pentane deasphalting, pentane-furfural partitioning, clay percolation, and oxidation. The treated products were subjected to Ames microbial mutagenicity testing or 10-animal mouse dermal tumorigenicity screening. The effects of treatment on dermal tumorigen PAH (especially BaP) in some of the treated products also were determined. The results confirm that distillation is a generally desirable first step in upgrading coal-derived liquids. Only the VGO fraction (or distillates containing VGO-boiling range material) shows significant positive results in mutagenicity and mouse skin tumorigenicity assays. Acid treatment, pentane deasphalting, and pentane-furfural partition were found to be promising for removing mutagenicity, but less effective in removing tumorigenicity from an H-Coal VGO. Alkaline treatment did not reduce mutagenicity but might remove tumor promoting agents. The effectiveness of both sulfuric acid and sodium hydroxide processes as pretreatments to improve toxicity mitigation by catalytic

hydrotreatment (over Pd/C or sulfided Shell 324 M nickel/molybdenum catalyst) was also investigated by laboratory hydrogenation of H-Coal VGO. Sulfuric acid pretreatment improved the reduction of BaP, especially in the case of Pd/C. However, sodium hydroxide pretreatment did not substantially improve BaP reduction. 21 refs., 8 tabs.

6892 **(DOE/CE/50070—T5) DOE Synthetic Fuel Center. Monthly progress report No. 1, November 1985.** Sefer, N.R.; Erwin, J. (Southwest Research Inst., San Antonio, TX (USA). Fuels and Lubricants Research Div.). 10 Dec 1985. Contract AC01-84CE50070. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003885.

The US Department of Energy under its contract DEAC01-84CE50070 established the Synthetic Fuel Center for the Alternative Fuels Utilization Program (AFUP) in the office of Vehicle and Engine Research and Development. Southwest Research Institute provided a new, high bay unit operations laboratory to house the center. The main component is a hydrogenation pilot plant for fuel processing. The mission of the Synthetic Fuel Center is to provide test quantities of special fuels to the research projects of the AFUP. The fuels have met defined composition and property objectives or have conformed to assessments of future fuel composition. These fuels are produced from divers sources including shale, coal, tar sands, and petroleum stocks and have included alcohols and vegetable oils. In the first three years of operation the Center completed the laboratory and pilot plant, provided 26 fuels to 11 AFUP projects, and made two presentations of its work and five roundtable discussions.

6893 **(DOE/MC/21385—1928) Advanced research in coal gasification process modification technology: catalytic cracking of aromatic hydrocarbons. Topical report, 1 October 1984-31 June 1985.** Simons, G.A.; Ham, D.A.; Moniz, G.A. (Physical Sciences, Inc., Andover, MA (USA)). Aug 1985. Contract AC21-84MC21385. 40p. (PSI—385/TR-528). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85016904.

The objective of this work is to screen inexpensive materials for potential use as disposable aromatic hydrocarbon (AHC) cracking catalysts in the reaction zone of the coal gasifier or in a fixed bed downstream from the gasifier. The approach is based on the conclusions reported in the literature that iron in a reduced state is an effective catalyst for AHC destruction. It therefore follows that chars or minerals with high iron content, high porosity, and high internal surface area will provide the most effective catalysts. We have screened all six of the following iron containing minerals: Siderite, Ankerite, Hematite, Magnetite, Pyrite, and Jarosite. The experimental tests measure the catalytic activity of these minerals for cracking benzene over the parameter range relevant to coal gasifier operation. Simulated coal gas containing 200 to 2000 ppM of model aromatic molecules will be used in all experiments and destruction of benzene will be measured over the temperature range 400 to 1000°C. The porosity and surface area of these minerals (partially decomposed in coal gas) will be determined and utilized in a computer model describing pore structure, species transport and surface chemistry to interpret the reactivity data in terms of the intrinsic reactivity of the reduced state of each mineral. These results will provide a basis for catalyst selection, coal selection and economic comparison. 3 refs., 15 figs., 3 tabs.

6894 **(DOE/PC/40009—T12) Advanced coal liquefaction catalyst development. Quarterly progress report No. 12.** Tait, A.M.; Mahoney, J.A.; Schwartz, M.M.; Wittrig, T.S.; Pacheco, M.A. (Amoco Research Center, Naperville, IL (USA)). Jun 1985. Contract AC22-81PC40009. 35p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003770.

The principle objective of Task 6 was to attempt to optimize the process conditions (temperature and space velocity) and catalyst composition for both bituminous and subbituminous coal in the Amoco two-stage coal liquefaction process. Pilot plant experiments have been conducted to determine the effect of these process variables on the process performance for Wyodak coal and Illinois No. 6 coal. This report presents the results of experiments that were performed on the pilot plant, AU-51, between July and September of 1984, inclusive. Two full-length catalyst aging runs were conducted during this reporting period. One experiment was designed to study the effect of first-stage space-time on the process performance with Wyodak subbituminous coal. The other experiment, with Illinois No. 6 bituminous coal, was designed to compare the effect of different second-stage catalysts. The major distinction between the two Ni-Mo/Al_2O_3 catalysts that were compared (Amocat-1C and shell 324M) is the pore size distribution of the support. The run conditions for the two pilot plant experiments have been summarized. The detailed data for both experiments, including coal conversions, product yields, and product quality, have been tabulated. Some results have been plotted herein for the purpose of illustration and discussion of results. Also, a brief summary of all runs conducted on AU-51 and a statement of their purpose has been provided. 15 figs., 4 tabs.

6895 **(DOE/PC/50798—T11) Catalyzed gasification of coal: isotope and XPS studies, August 16-November 15, 1985.** Falconer, J.L. (Colorado Univ., Boulder (USA)). 20 Nov 1985. Contract FG22-82PC50798. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003757.

This research aims to elucidate the reaction mechanism for the catalytic gasification of coal by metal carbonates, by identifying the reaction pathways and the active form of the catalyst. The insight into the mechanism will help in improving process kinetics of coal gasification. Alkali carbonates and alkaline earth carbonates are being used to catalyze the carbon dioxide-carbon gasification reaction. Temperature-programmed reaction, isotopic labeling of the carbon and oxygen atoms in the carbonate, and mass spectrometric detection of labeled products are used to identify reaction pathways, x-ray photoelectron spectroscopy (XPS) analysis of carbon-carbonate mixtures is used, at reaction conditions, to determine the chemical state of the carbonate.

6896 **(DOE/PC/50800—T12) Transport and relaxation processes in supercritical fluids. Technical progress report, July 1-September 30, 1985.** Jonas, J. (Illinois Univ., Urbana (USA). Dept. of Chemistry). 1985. Contract FG22-82PC50800. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002921.

Among the studies presented in this report are: FTIR measurements of solubilities of anthracene in supercritical carbon dioxide, and NMR study of solid naphthalene solubilities in supercritical carbon dioxide near the upper critical end point. Experimental work on transport and relaxation properties of solid-supercritical fluid systems is in progress. 1 tab. (PLG)

6897 **(DOE/PC/60039—7) Phase behavior of coal fluids: data for correlation development, August 1-October 31, 1985.** Robinson, R.L. Jr. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 1985. Contract FG22-83PC60039. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003565.

The overall objective of the author's work is to develop accurate predictive methods for representation of vapor-liquid equilibria in systems encountered in coal-conversion processes. The objectives of the present project include: (1) measurements of binary vapor-liquid phase behavior data for selected solute gases (e.g., H_2, CO, CO_2, NH_3, H_2S) in a series of heavy, primarily aromatic, solvents (e.g., benzene, naphthalene, phenanthrene) to permit evaluation of interaction parameters in models for phase behavior. Both solubilities of the gases in the liquid phase and of the heavy solvents in the gas phase will be determined; (2) measurements on ternary systems in which high-melting-point solvents (e.g., pyrene, chrysene, triphenylene) are dissolved in more volatile aromatics to provide mixed solvents; this will facilitate measurements at lower temperatures than would be possible in the pure high-melting-point aromatic solvents, which would be solid at operating conditions; (3) evaluation of existing equations-of-state and other models for representation of phase behavior in systems of the type studied experimentally; development of new correlation frameworks as needed; and (4) generalization of the interaction parameters for the solutes studied to a wide spectrum of heavy solvents; presentation of final results in formats useful in the design/optimization of coal liquefaction processes. During the present report period, data have been obtained on the solubilities of ethane in n-decane at 310.9, 344.2,

377.6 and 410.9 K, in naphthalene at 373.2 and 423.2 K, in phenanthrene at 383.2 and 423.2 K, and in pyrene at 433.2 K. These data are well described by the Soave and Peng-Robinson equations of state. 9 refs., 1 fig., 6 tabs.

6898 **(DOE/PC/63032—T6) Bench scale development of the TRW process for cleaning coal (Gravimelt process). Quarterly technical progress report, May 1985-July 1985.** (TRW Space and Technology Group, Redondo Beach, CA (USA)). Aug 1985. Contract AC22-83PC63032. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85018277.

The major sections of the 20 lb/h modular test plant were designed and the necessary equipment specifications were prepared. A competitive procurement was initiated for the reaction section, a rotary kiln with coal and caustic feed capability. Two kiln tests were performed at a vendor test facility to provide design data, demonstrate continuous around the clock operation and to provide coal and spent caustic feed for regeneration and filtration equipment tests. The first two objectives were successful and accomplishment of the second objective will be assessed next month. Experimentation for scale-up and verification testing of the regeneration section was performed. A description of the modular test plant and the detailed engineering and test results are presented in five sections entitled: Modular Test Plant; Rotary Kiln Tests; Rotary Kiln Specifications; Regeneration Verification Tests and Regeneration Section Design. 1 fig., 3 tabs.

6899 **(DOE/PC/63032—T7) Bench scale development of the TRW process for cleaning coal (Gravimelt process). Quarterly technical progress report, August-October 1985.** (TRW Space and Technology Group, Redondo Beach, CA (USA)). Nov 1985. Contract AC22-83PC63032. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003911.

Construction of the 20 lb per hour modular test plant has been initiated and all major equipment has been received with the exception of the caustic-water evaporator and the rotary kiln, which are scheduled for December and January, respectively. Construction, checkout and shakedown is on schedule with the three sections of the modular test plant planned for completion together with checkout and shakedown by March. A topical report containing the detailed plant design, shakedown plans and a preliminary test plan was submitted to the DOE. A third kiln test was successfully performed at the kiln vendor test facility to provide information on long-term operation of the kiln as well as a supply of coal-caustic products sufficient for shakedown of both the filtration and regeneration sections of the modular test plant. Regeneration verification and intermediate scale up testing, initiated last quarter, was completed resulting in a confirmation and refining of the data previously obtained for regeneration. Considerable information was also generated on the filtration of spent caustic solution. It was determined that mineral matter reject contains only $1 worth of caustic per ton of coal processed. This study will be presented in detail in a topical report to be issued this month. Filtration testing of separation of concentrated caustic-coal slurries was conducted both at laboratory scale utilizing an 0.1 square foot leaf filter and in a commercial one square foot rotary drum vacuum filter. The observed laboratory cake moisture level of 2.6 to 1 w/w decreased to 2.2 when performed in the one square foot rotary vacuum drum filter. 2 figs., 2 tabs.

6900 **(DOE/PC/70003—T6) Coal pretreatment for two stage liquefaction. Quarterly report, July 1-September 30, 1985.** Derbyshire, F.J.; Luckie, P.T. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). 1985. Contract FG22-84PC70003. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002987.

The overall objectives of the contract are to investigate the fundamental problems and technical feasibility of selectively separating coal constituents and to determine the effects of the substantial removal of inorganic components or individual macerals on coal liquefaction. Experiments using tubing bomb reactors have shown that low-severity catalytic hydrogenation, prior to reaction at higher temperatures, can promote overall conversion and can advantageously influence product selectivity. Namely, the oil to asphaltene ratio is enhanced with little or no attendant increase in gas make. The results of further exploratory experiments indicate that this performance can be further improved through the judicious selection of reaction conditions and through altering the composition of the liquefaction solvent. Work has continued in assembling the autoclave reactor system. It is anticipated that the system will be in operation by November. 6 refs., 7 figs., 2 tabs.

6901 **(DOE/PC/72008—T3) Development of a microwave coal cleaning process. Technical progress report, June 1985-August 1985.** (TRW Space and Technology Group, Redondo Beach, CA (USA)). Sep 1985. Contract AC22-84PC72008. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86000312.

The objective of the program is to conduct bench scale studies to evaluate a process using microwave irradiation of caustic treated coal to remove sulfur and ash from coal. The program is organized into three tasks: equipment design and installation, shakedown testing, and process testing. This report describes the completion of Task 1, including equipment installation, preparation of operating procedures, completion of the test readiness review process, and results of verification testing of sampling and analytical procedures. Also presented are the results of the initial activities of Task 2, including shakedown of the mechanical systems, the blend/filter coal pretreatment function, and the microwave reactor system. 2 figs., 14 tabs.

6902 **(DOE/PC/79892—T4) Coal liquefaction study under the nonisothermal reaction temperature. Quarterly progress report, July-September 1985.** Kwon, K.C. (Tuskegee Inst., AL (USA). Dept. of Chemical Engineering). 1985. Contract FG22-84PC79892. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003270.

Effects of heating rates on liquefaction of Kentucky No. 9 Coal were investigated in the presence of various hydrogen donor solvents as part of Task I. A series of coal liquefaction runs were conducted, increasing coal liquefaction temperatures from 200°C or 300°C up to 380°C in order to investigate effects of heating rates on liquefaction of Kentucky No. 9 coal in the presence of various hydrogen donor solvents. Another series of coal liquefaction runs were performed, increasing liquefaction temperatures from 200°C or 300°C up to 380°C and holding liquefaction temperatures at 380°C for 15 minutes to identify roles of hydrogen donor solvents in the early stage of coal liquefaction. 13 figs., 8 tabs.

6903 **(DOE/PC/80016—T1) Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction. Topical report No. 1: the project work plan.** McCarty, J.G.; Wilson, R.B.; Wood, B.J. (SRI International, Menlo Park, CA (USA)). 15 Nov 1985. Contract AC22-85PC80016. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002986.

The goal of SRI's research program is to narrow the FT product distribution through two methods of catalyst development. The first approach consists of the organometallic synthesis of multiatomic ruthenium and iron-ruthenium alkyl-carbonyl clusters, the reaction of these clusters with acidic alumina or silica-alumina supports and the activation and characterization of these surface-confined clusters by temperature programmed decomposition and infrared spectroscopy. This method will focus on the development of very active FT catalysts with low wax yield. In the second approach, conventional promoted and unpromoted Fe, Co, and Ru catalysts will be treated by uniform deposition of low submonolayer levels of chemisorbed sulfur. This method will focus on selectively suppressing methane production. Catalysts developed by both methods will be given common characterization measurements and tested for their catalytic activity and FT product distribution relative to a standard precipitated iron catalyst. Those catalysts that promise significant improvement in selectivity will be further evaluated in bench-scale laboratory tests under realistic FT reactor conditions. 23 refs., 6 figs., 6 tabs.

6904 **(EPRI-AP—4253-SR) Tenth annual EPRI contractors' conference on clean liquid and solid fuels: proceedings.** (Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1985. 780p. (CONF-8504130—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920056.

From 10. annual EPRI contractors' conference on coal liquefaction; Palo Alto, CA, USA (23 Apr 1985).

EPRI's Tenth Annual Contractors' Conference on Clean Liquid and Solid Fuels was held on April 23, 24, and 25, 1985 in Palo Alto, California. The conference featured results of work on coal science, coal liquefaction, methanol production, coal oil coprocessing and coal upgrading. All papers have been processed for inclusion in the Energy Data Base.

6905 **(EPRI-AP—4344) Corrosion in quench systems of entrained slagging gasifiers: a laboratory study. Final report.** Bhattacharyya, S. (IIT Research Inst., Chicago, IL (USA)). Nov 1985. 61p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920059.

The objective of this program was to conduct laboratory autoclave tests simulating environments of the gray water system of an entrained slagging gasifier plant. Five tests (one 200-h and four 1000-h) were conducted using ferritic steel material 1 1/4Cr-1/2Mo (T-11) and 14% silicon cast iron; austenitic stainless steels 304L, 316, 321, and Sanicro 28; duplex stainless steel 2205; and Incoloy 825. In the vapor phase with autoclave solution pH in the 4.5 to 4.8 range, 304L SS, 316 SS, 321 SS, and Incoloy 825 double U-bends suffered significant intergranular SCC. Some crevice-assisted cracking is suspected. Pitting corrosion, as measured by maximum pit depth, may become serious since the rate of growth is not known. At the pit base, preferential dissolution was identified similar to grain- and twin-boundary preferential corrosion. General corrosion of the stainless steels was low, but T-11 and 14% silicon cast iron cannot be used unprotected. High acidic pH (6.2 and 6.4) and lower total chloride levels eliminated SCC problems and reduced pitting and corrosion. Of the two phases in a quench system, the vapor phase poses more danger to the materials of construction, particularly to the internal attachments and extensions where welding is required. 13 refs., 31 figs., 4 tabs.

6906 **(EPRI-AP—4345) Non-coal-derived heavy solvents in direct coal liquefaction.** Miller, R.L. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). Nov 1985. 118p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920055.

Results from an exploratory experimental study of liquefaction co-processing using Wyodak subbituminous coal and six non-coal-derived heavy oil samples are reported. The data suggest that relatively high C_4-850°F distillate yields and pyridine conversiom values can be achieved even at the mild liquefaction reaction conditions used in this work. An apparent synergism towards distillate production is noted when coal and heavy oil are converted simultaneously. This synergism is attributed to increased heavy oil reactivity in the presence of coal. However, only small amounts of coal (2 to 5 wt % of total coal/heavy oil feed) are required for the enhanced reactivity of contribute to overall process improvement. Results from two four-factor experimental designs demonstrate that gas atmosphere, distillate solvent composition and hydrogen donor ability, and use of a disposal catalyst each affect distillate yield and pyridine coal conversion at the reaction conditions studied. Properties of the feed heavy oil also affect liquefaction co-processing performance. The largest C_4-850°F distillate yields (>50 wt % MAF coal basis) were obtained using a mid-Continental petroleum 850°F+ heavy oil sample and a mildly hydrotreated shale oil sample. The use of carbon monoxide as feed gas rather than hydrogen generally resulted in reduced process performance. However, selected runs at reaction conditions more conductive to CO/H_2O aqueous ionic reaction chemistry gave C_4-850°F distillate yields in excess of 50 wt % MAF coal basis. 62 refs., 22 figs., 21 tabs.

6907 **(EUR—9382) Effect of hydrogen and specific catalysts on the production of synthetic fuels.** Chiche, P.; Pregermain, S.; Charcosset, H.; Andres-Besson, M. (Commission of the European Communities, Luxembourg). 1984. 99p. (In French). Commission of the European Communities, Luxembourg.

Two types of iron catalyst were studied: a very finely divided iron oxide catalyst (0,05 μm) obtained by thermal decomposition in a flame of a starting (iron) compound ("Blow-lamp" oxides), an iron hydroxide catalyst with particle size in the micrometre range prepared by precipitation from a laboratory-prepared solution or from a solution supplied by industry ("industrial oxides"). The following general points arose out of the laboratory tests: acidified clays do not present significant and reproducible effects; the activity of certain iron catalysts, notably the "blow-lamp" and "industrial" oxides, is comparable to that of the reference catalyst Ni-Mo/Al_2O_3. These oxides can be used in very low concentrations - less than or equal to 0.5% of coal; the activity of red mud is considerably less, thereby requiring the use of a higher concentration - of the order of 5% of coal; better results are obtained by increasing the partial pressure of hydrogen; while low-rank coals are more suited to liquefaction, the use of catalysts and variation of hydrogen partial pressure have a lesser effect in this case. The pilot-plant tests have confirmed the activity of iron catalysts in terms of the sustained hydrogenation capability of the recycle solvent, the overall conversion of coal and distribution of useful liquid products. However, the type of catalyst and catalyser have little effect on the yield of gaseous hydrocarbon products.

6908 **(NEDO-OS—8404) Coal conversion technology. FY 1983 annual report.** (New Energy Development Organization, Tokyo (Japan)). 1984. 265p. NTIS (US Sales Only), PC A12/MF A01. File Number DE86900211.

The results of research programs in coal liquefaction and coal gasification are reported. (LTN)

6909 **(PNL—5556) Decommissioning samples from the Ft. Lewis, WA, solvent refined coal pilot plant: chemical analysis and biological testing.** Weimer, W.C.; Wright, C.W. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 89p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86003938.

This report presents the results from chemical analyses and limited biological assays of three sets of samples from the Ft. Lewis, WA solvent refined coal (SRC) pilot plant. The samples were collected during the process of decommissioning this facility. Chemical composition was determined for chemical class fractions of the samples by using high-resolution gas chromatography (GC), high-resolution GC/mass spectrometry (MS) and high-resolution MS. Biological activity was measuring using both the histidine reversion microbial mutagenicity assay with Salmonella typhimurium, TA98 and an initiation/promotion mouse-skin tumorigenicity assay. 19 refs., 7 figs., 27 tabs.

0105 BY-PRODUCTS

REFER ALSO TO CITATION(S) 7062

0106 PROPERTIES

REFER ALSO TO CITATION(S) 6897, 6904, 6926, 6928, 6929, 7556, 7560

6910 (CONF-850297—, pp 84-107) **Coal-water mixture fuel and preliminary studies on its rheological characteristics.** Chakraborty, M. (Central Fuel Research Institute, Dhanbad, India). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

Coal-water mixture (CWM) behaves like a fluid and can be used as a low-cost substitute for petroleum-based fuel. Major development projects have been undertaken in many countries in order to establish and commercialize the technology. In Part I of the paper, characteristics and potential fields of application of CWM fuel and present status of the technology, including Indian effort, have been briefly reviewed. The technology of CWM fuel is relatively straight-forward and does not pose an environmental problem. The economic viability of CWM over residual fuel oil is also encouraging, the price differential of these two fuels being over $2.0/GJ (Rs.20.00/GJ). The preliminary rheological studies of CWM prepared with a few Indian coals and conducted at Pitts-

burgh Energy Technology Center, USA, are reported in Part II. From the limited experimental results, it has been observed that the character and concentration of coals and dispersing agents used had a strong effect on the viscosity. It was possible to correlate the viscosity data by means of an empirical equation available in literature. The nature of the particular coal-water dispersion was slightly thixotropic and similar to Bingham plastic. More experimental evidence are, however, necessary to confirm these observations. 12 refs., 7 figs., 3 tabs.

0911 (CONF-851003—13) Effects of surface immobilization on the thermolysis of coal model compounds. Buchanan, A.C. III; Dunstan, T.D.J.; Poutsma, M.L. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002251.

From Conference on coal science; Sydney, Australia (28 Oct 1985).

Thermal reaction pathways for model coal structures (α, ω-diphenylalkanes) covalently bonded to an inert silica surface are being investigated. Major changes are observed in the free radical reaction pathways for surface attached bibenzyl compared with its fluid phase behavior. Surface immobilization can promote unimolecular decay pathways (e.g., rearrangement, cyclization) relative to competing bimolecular pathways (e.g., coupling, disproportionation) for surface attached radicals. 10 refs., 1 tab.

0912 (DOE/EV/10237—T2) Identification of polycyclic aromatic compounds containing two heteroatoms in coal liquids and shale oils. Technical progress report, March 1, 1983-October 31, 1985. Lee, M.L.; Castle, R.N. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry; University of South Florida, Tampa (USA). Dept. of Chemistry). 1985. Contract AC02-79EV10237. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003859.

The methodology has been developed for isolating and identifying components of five new classes of PAC in coal liquids. The methods have been applied to one coal liquid (and a coal tar for comparison). The major contributions of this work to DOE health and environmental science issues are as follows: (a) A superior sulfur heterocycle isolation method, based on ligand exchange chromatography, has been developed. (b) Methods have been developed using adsorption chromatography and gas chromatographic selective detection to isolate, detect, identify, and quantify the amino sulfur heterocycles, the amino nitrogen heterocycles, the hydroxy sulfur heterocycles, the hydroxy nitrogen heterocycles, and the azathiophenic compounds in coal-derived materials. (c) A large number of standard reference compounds have been synthesized. (d) Two new gas chromatographic stationary phases have been applied to the resolution of these isomeric PAC. (e) The aminodibenzothiophenes have been found to possess significant mutagenic activity in the Ames Assay. (f) A fractionation method for PAC based on the number of aromatic rings using supercritical carbon dioxide has been developed. Recommendations for future work in this area are given. 68 refs.

0913 (DOE/PC/60800—8) Active sites in char gasification. Quarterly technical progress report, 1 July 1985-30 September 1985. Calo, J.M.; Suuberg, E.M.; Wojtowicz, M.; Lilly, W. (Brown Univ., Providence, RI (USA). Div. of Engineering). 1985. Contract FG22-83PC60800. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003575.

This project is concerned with the study of the nature and behavior of "active sites" in the gasification of chars produced from synthesized model compounds, primarily those of the phenol-formaldehyde family of resins. Of the various techniques that have been identified to accomplish the objectives of this project, the development of a reliable measure of the total active surface area (TASA) of the chars is one of the most important. The primary technique that has been pursued in the current work is O_2 chemisorption (see DOE/PC60800-4 and DOE/PC60800-6). Most of the experimental problems originally encountered have now been overcome, and in the current report we present data on surface areas, active (TASA) and total (TSA) for chars derived from phenol-formaldehyde resins. The general conclusions that can be derived from this work include that: (1) TASA generally decreases with increasing heat treatment temperature; (2) CO_2 gasification rates of these chars at 950°C, atmospheric pressure, relative to TASA, are reasonably constant, while those relative to total surface area (TSA), determined by N_2 BET, show considerable variation. Therefore, TASA seems to be a better parameter for characterizing the reactivities of the current model compound chars. 23 refs., 3 figs., 2 tabs.

0914 (DOE/PC/70773—T1) Macromolecular structure of low rank coals and lignites. Report for the period: June 1-November 1, 1985. Baskar, A.J.; Larsen, J.W.; Wei, Y.C. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 26 Nov 1985. Contract FG22-84PC70773. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003622.

Diffuse reflectance infrared Fourier transform (DRIFT) spectroscopy has been employed in studies of hydrogen bonds in Bruceton and pyridine-extracted Bruceton coals. The use of a controlled environment cell in these studies precluded interferences from atmospheric oxygen and water vapor. Additionally, a vacuum line was attached to the cell to facilitate vapor swelling of the coals as function of time. Spectra were collected of both parent coals and the coals exposed to pyridine vapor. Shifts in the broad envelopes of bands in the free and hydrogen-bonded -OH and -NH regions of the spectra are related to the strengths of hydrogen-bond interactions in the coals.

0915 (DOE/PC/70778—T5) Measurement and control of electrostatic charges on solids in a gaseous suspension. Technical progress report No. 5. Nieh, S.; Nguyen, T. (Catholic Univ. of America, Washington, DC. Dept. of Mechanical Engineering). Oct 1985. Contract FG22-84PC70778. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003037.

Measurements of mean particle charges and charge distributions on Medium Volatile Bituminous (MVB) coals and Lignite A (LIGA) coals in a 51 mm ID grounded copper pipe loop have been made with the upgraded Faraday cage system. Both negative and positive charges were found for coals in all experiments. The dual polarities of charges are believed to be due to the nonuniform materials and chemical composition contained in coals. As expected, increasing velocity or decreasing air humidity has a significant effect to increase the mean particle charge and the standard deviation of distribution. Charge elimination by the addition of coal fines has been explored. Effective suppression of particle charges was achieved by adding 0.1% by mass of minus 1 μm coal dust into the pipe flow. A neutralization mechanism was proposed to interpret the measured results. The results of charge control obtained to date has been significant and encouraging. More work is needed to validate the proposed mechanism. 16 refs., 9 figs., 5 tabs.

0916 (DOE/PC/70795—T5) Macromolecular chemistry of coalification. Quarterly report, August 1-October 31, 1985. Kovac, J.; Crabb, C.C. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 20 Nov 1985. Contract FG22-84PC70795. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003736.

In this paper we apply the modified Gaussian model for the freely jointed chain to the problem of the entanglement constraints on a chain in a rubbery polymeric solid to describe the structure of coal. The entanglement constraints are incorporated by confining the polymer chain to a tube. We confine the chain within a hard square tube. As the macroscopic system is deformed the tube deforms affinely in length while maintaining a square cross section and a constant volume. Modified Gaussian statistics are used for the polymer chain.

0917 (DOE/PC/80521—T1) Acid-base properties of coals and other solids. Quarterly report, September 1, 1985-November 30, 1985. Arnett, E.M. (Duke Univ., Durham, NC (USA). Dept. of Chemistry). 1985. Contract FG22-85PC80521. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003641.

In order to compare the behavior of different samples of solid adsorbants there must be a quantitative means for determining surface areas and the degree of monolayer coverage, pore size distribution, and total pore volume. To this end we have used a Quan-

tachrome Quantasorb Surface Area Analyzer which characterizes these properties using the Brunauer, Emmett and Teller extension of the Langmuir kinetic theory to multilayer adsorption. As the temperature is increased and the pressure held at 1000 psi the heat of interaction for all compounds decreases compared to their values at 30°. In most cases this is a monotonous decrease. We attribute this behavior in the first instance to disruption of the hydrogen bonding interaction between the silica and the base, but note a somewhat surprising fact for n-propylamine, iso-propylamine, t-butylamine and triethylamine: namely that although these four bases have widely different heats of interaction at 30°, all four of them have moved within experimental error to a common value close to -14 calories per gram of silica. We cannot tell at this time how much of the variation in the heats of interaction are due to changes in heats of adsorption and how much is due to the bizarre variations in heats of mixing, which have been observed by other workers as the critical point is approached and passed through. What is clear is that there are large changes in the enthalpies of interactions as these bases change from ambient towards the supercritical region, and there is every reason to expect that such variations also occur in catalytic systems, geothermal systems and fossil fuel systems. 11 refs., 7 figs., 3 tabs.

6918 **ACS Symposium Series 205. (Coal and coal products: analytical characterization techniques).** Washington, DC; American Chemical Society (1982). 326p.

This book examines specific areas of technical importance in coal processing and utilization, and describes specific applications of methods of analysis to various coals and/or derived products. Topics considered include the carbonization of coal and coal blends, the characterization of alkanes in coal extracts, Fourier transform IR spectroscopy, the chemistry and structure of coals, elemental analysis of coal and fly ash, inductively coupled plasma atomic emission spectrometry, the determination of chlorine in coal, electron probe microanalysis, the analysis of process streams of low Btu gasifier effluents, solvent analysis of coal-derived products, scanning electron microscope-based automated image analysis, Moessbauer spectroscopy, analytical instruments in coal preparation plants, the use of coal in the steel industry, and the electron optical and IR spectroscopic investigation of coal carbonization.

0108 WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 6889, 6937, 7807

6919 **(DOE/PC/81008—T1) Direct sorbent injection for combined SO_2/NO/sub x/ removal. Technical progress quarterly report, August-September 1985.** Dowdy, T.E. (Tennessee Univ., Tullahoma (USA). Space Inst.). 1985. Contract AC22-85PC81008. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001551.

The objective of this project is to experimentally confirm the feasibility of a low-cost system for simultaneous SO_2 and NO/sub x/ control. The approach to be taken is to simulate the injection of active SO_2 and NO/sub x/ sorbents or reactants directly into the flue gas ductwork. The major activities during the first two months have been to prepare a detailed Project Work Plan and to begin the design, procurement and construction of the test facility. This quarterly report summarizes the technical progress to date. As much of the effort has been directed toward planning, this report reflects the technical plans that have been made. The construction and installation through this period has included the relocation and installation of the existing hardware components to be used on this project. The baghouse has been relocated and insulated. The fan has been relocated and mounted. A gas cooled/moisture condenser has been fabricated and installed. A flow straightener has been designed, fabricated and installed. Exterior duct work has been fabricated, insulated and sealed and installed. Design and procurement activities have included finalizing process flow rates and conditions, generating a final layout of equipment and specifying long items. Technical planning activities have included identifying sampling and analytical procedures to be used, identifying analytical instrumentation and data acquisition requirements, identifying special data acquisition needs (i.e. laser velocimeters and shadow spectrometer) and preparing a preliminary overall test plan. A detailed test plan will be issued at a later date. 9 refs., 19 figs., 3 tabs.

0109 ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 6937, 6938, 7809

6920 **(DOE/LC/10402—1920) Effects of aqueous effluents from in situ fossil fuel processing technologies on aquatic systems. Progress report, 1 January 1980-1 November 1981.** Bergman, H.L. (Wyoming Univ., Laramie (USA)). Mar 1985. Contract AS20-80LC10402. 51p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85011525.

During 1980, we completed the literature review task with publication of Volumes 1 and 2 of the "Bibliography of Aquatic Ecosystem Effects, Analytical Methods and Treatment Technologies for Organic Compounds in Advanced Fossil-Fuel Processing Effluents." A summary of work completed on all process waters evaluated during this project (15 May 1977 through 1 November 1981) is presented. A total of 32 process waters from coal gasification, oil shale retorting and tar sands extraction have been evaluated through our screening steps that include chemical toxicity, degradation and bioaccumulation testing. For the current reporting period we have completed work on 9 process water samples or sample sets: (1) the embryo-larval bioassay exposing fathead minnows (Pimephales promelas) to Hanna-4B-01W coal gasification condenser water; (2) toxicant avoidance bioassays with the same Hanna-4B sample; (3) acute toxicity bioassays of chemical fractions of Hanna-3 (CGR-76-178) coal gasification condenser water; (4) Occidental-6 oil shale retort water (embryo-larval bioassays on fathead minnows and rainbow trout); (5) Lawrence Livermore Run-4 oil shale retort water (chemical characterization, acute toxicity tests, and toxicant avoidance tests); (6) Geokinetics-17 oil shale retort water (chemical characterization and acute toxicity tests); (7) Omega-9, Geokinetics-9, and Paraho Tank 500 oil shale retort waters (fractional toxicity tests); and (8) one major tar sands process water, Vernal tar sands water (80-Tarsand-1S-03W-00-C). Because this sample was produced as a stable oil-water emulsion, it was necessary to treat the sample in various ways producing several treated water samples which were characterized along with the raw water.

0110 RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 6936

0120 MINING

6921 **(NP—6770047) Contribution to the projecting and monitoring of trackless transportation systems in underground coal mining.** Schwenke, M. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 2 Nov 1984. 210p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770047.

A model is presented which may be applied in the design of trackless transportation systems and which provides the user with information on the operating characteristics of a system in dependence of technical and organisational influencing parameters. Further, it enables him to assess the effects of trackless vehicles on other areas of a mine.

0130 TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 6898, 6899, 6901, 6915, 7179

6922 **(ANL/FE—85-12) Evaluation of active ultrasonic cross-correlation technique in coal/liquid pipe flow measurements.** Sheen, S.H.; Raptis, A.C.; Bobis, J.P.; Lee, S.; Simpson, T. (Argonne National Lab., IL (USA)). Oct 1985. Contract W-31-109-ENG-38. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86004179.

The active acoustic cross-correlation technique has been assessed experimentally and theoretically for use as an online flow calibration method for coal/liquid pipe flows. An analytical model

was developed to study the dependence of the average transit time on the velocity profile in the pipe and to measure the effect of experimental parameters such as pipe diameter, sensing geometry, and sensor separation. Two flow tests using coal/oil and coal/water slurries were conducted at the Argonne National Laboratory (ANL) Solid/Liquid Flow Test Facility (SLFTF). For both tests, the coal concentration was increased in steps from 0 to 70 wt% and the average flow velocity varied between 0.2 and 3.8 m/s. Results show that the flow velocity deduced from the cross-correlation peak is, for most cases, about 15% higher than the average velocity measured by the flow diversion technique. The difference increases to about 40% for coal/oil slurries with concentrations of 40 to 60 wt% when particle settling in the horizontal line occurs. The flow calibration instrument based on the cross-correlation technique is presented. 24 refs., 31 figs., 8 tabs.

0023 (CONF-840852—Pt.1, pp 113-118) **Peat drying.** Asmussen, D. 8 Aug 1984. NTIS MF A01. File Number DE85008377.

From Fiber Fuels Institute summer trade show and technical conference; Superior, WI, USA (7 Aug 1984).

An overview is presented on the moisture-holding properties of peat and the major methods of peat drying. Of the three major peat drying techniques - solar, mechanical, and thermal/chemical, solar remains the technique of choice for most current operations producing fuel or horticultural peat. This is true for reasons of solar's lower costs and technical simplicity. Should traditional fuels, especially coal, experience dramatic price increases in the future, the use of the other, more costly, peat drying techniques might become economically feasible. 5 refs.

0024 (CONF-850297—, pp 178-188) **Beneficiation of difficult cleaning coking coal.** Chakravarti, A.K. (Central Fuel Research Institute, Dhanbad, India). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

By washing Indian coals, in a conventional manner, a good percentage of by-product as middlings/sinks with ash content 40 to 50% is obtained which do not have direct use in metallurgical coke making. Studies at CFRI have indicated that clean coal to the extent of 50% on the yield of middlings/sinks can be recovered by finely grinding, followed by beneficiation by a suitable technique. Thus, by retreatment of the by-product, it may be possible to increase the yield of clean coal to the satisfactory level from Indian coking coals. This paper describes this method of coal beneficiation. 6 refs., 5 tabs.

0025 **(DOE/EI/10653—T1) Coal based synthetic fuel technology assessment guides.** (Energy Resources Co., Inc., Cambridge, MA (USA)). Sep 1981. Contract AC01-80EI10653. 777p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85017607.

Seventeen synthetic fuel processes are described in detail and compared on a uniform basis. This work was supported by the Energy Information Administration for the purpose of technology assessment of the processes, their efficiency, the capitalized and operating cost of plants of similar size, possible constraints, possible siting problems, regional effects, pollution control, etc. (LTN)

0026 **(DOE/MC/21315—T1) Literature review for steam pretreatment.** Brandes, S.D.; Graff, R.A. (City Univ. of New York, NY (USA)). Feb 1985. Contract AC21-84MC21315. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86002833.

A literature survey has been conducted to support an experimental investigation of steam pretreatment of coal for improving liquid yields and quality in gasification processes. Experiments have so far shown pretreatment to be effective from 320 to 360°C in 50 atm. steam. Information on thermal effects, steam reactivity, and phase equilibrium at temperatures and pressures which are relevant, but not restricted, to these conditions have been reviewed. Evidence for thermal activity below 350°C comes from observation of softening and/or melting, acidity, volatiles loss, solvent extraction, differential thermal analysis, differential scanning calorimetry, electron spin resonance, and mild oxidation reactions. Reaction of steam with shale oils at 425°C and with coal and model compounds in the neighborhood of the critical point have been reported. Phase equilibrium data show complete mutual solubility of water and aromatic hydrocarbons at conditions approaching those of pretreatment. A few pretreatments reported for other processes are noted. A survey of studies of weathering is included for its possible relevance to the observed sensitivity of pretreated coal to ambient air exposure. These literature citations corroborate our experimental findings and offer possible explanations for pretreatment. To discriminate among these possibilities and to provide a more detailed picture of the processes will require further experimental work. 85 refs.

0027 **(DOE/PC/72001—T1) Novel separatory method for controlling the quality of fine coal. Final report.** Ayat, G. (Kentucky Univ., Lexington (USA). Dept. of Mining Engineering). Aug 1985. Contract AC22-84PC72001. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86002457.

This project involved the development of a novel tagging and tracing technique that has specific application to the evaluation of the performance of fine coal cleaning processes. The technique employs tagged synthetic particles or coal particles representing specific sizes and densities of coal. Theoretically, these tagged particles are incorporated into the feed to the processing circuit, and are then detected and counted individually at locations in the coal product and refuse streams. The detection of the tracer particles is accompliahed by detecting magnetized trace particles with a detector. Provided that the tagged particles represent the coal particles, and that a suitable means of detection is available, this technique can provide partition data for a given coal cleaning device. The technique would be useful for plant diagnostics and/or control. Research efforts have resulted in the identification of several methods for tagging coal and synthetic particles including magnetic, radioactive and fluorescent techniques. A method has been developed to manufacture synthetic magnetic particles of various sizes and specific gravities. These synthetic particles have been examined in order to assess how well they represent the coal particles processing in various coal washing separatory devices. Results of these tests have indicated that the synthetic magnetic particles behave similarly to the coal particles. Research work on the development of a suitable detection system for the synthetic magnetic particles has produced promising results.

0028 **(DOE/PC/72007—T6) Ultra-fine coal characterization. Sixth quarterly report, June 1-August 31, 1985.** Smit, F.J.; Odekirk, J.R. (AMAX Extractive Research and Development, Inc., Golden, CO (USA)). 20 Sep 1985. Contract AC22-84PC72007. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003734.

This report covers the sixth quarter of activity characterizing the mineral-matter liberation and the beneficiation of ultra-fine coal. Bulk properties and the ultrafine grinding of two coals - Indiana III and Illinois No. 5 - are reported. In addition, experimental studies were started to model the froth flotation of the ultra-fine coal and especially to relate the liberation characteristics to the product quality. 7 refs., 2 figs., 23 tabs.

0029 **(DOE/PC/80514—01) Chemistry and reactivity of micronized coals. Technical progress report No. 1.** Lloyd, W.G.; Riley, J.T.; Kuehn, K.W. (Western Kentucky Univ., Bowling Green (USA). Ogden Coll. of Science, Technology and Health). 15 Nov 1985. Contract FG22-85PC80514. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003826.

This project examines the effect of micronizing coals (reducing mean particle size to 1 to 10 microns) upon their chemistry and reactivity. This is a first technical progress report, written prior to the arrival of the attritor mill which will be central to most of the subsequent work. Two fresh coals have been acquired, reduced and characterized. Two additional coals will have been acquired by the end of this calendar year. A four-hour attrition run has been made, with the same model of attritor mill which we will be using in future work, and with a high-ash Illinois No. 6 coal. The pattern of particle size reduction is shown and discussed. A transient bimodal distribution can be clearly seen. The hydroliquefaction apparatus is

completed. Agitator speed is shown to be a smooth function of supplied voltage. Hydroliquefaction conversions from slurries of micronized coals requires a special assay technique. A method entailing slurrying in hot dimethylformamide followed by collection on an appropriate membrane filter yields excellent results in preliminary testing. 5 figs., 4 tabs.

0140 COMBUSTION

REFER ALSO TO CITATION(S) 6889, 7663, 7664, 7807, 7808

6930 (CONF-850297—, pp 44-66) **Evaluation of freeboard performance in a fluidised bed combustor.** Krishnan, R.P.; Chandrasekaran, S.; Murthy, A.V.V.; Bhaskaran, C.; Shanmugam, S. (Oak Ridge National Lab., TN; Bharat Heavy Electricals Ltd., Tiruchirapalli, India). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

A collaborative research project funded by the US Agency for International Development (USAID) and Bharat Heavy Electricals Limited (BHEL), has been initiated at the BHEL high pressure boiler plant site in Trichy, India. The project involves the design, erection and commissioning of a one metre square cross section atmospheric fluidised bed combustor (AFBC). The test facility will be used to obtain engineering and performance data on the combustion and heat transfer in the freeboard region of the AFBC. High-ash Indian coals, low grade fuels and high-sulfur US coals will be tested in the combustor. The Energy Systems Group (ESG) at BHEL, Trichy and the Oak Ridge National Laboratory, USA have the joint echnical responsibility for carrying out the project. This paper describes the objectives, project schedule, current status, design details of the combustor and auxiliary systems, test program and instrumentation and control. 5 refs., 10 figs.

6931 (CONF-850297—, pp 67-83) **AFBC boiler scale-up.** Malarkkan, K.M.V.; Sundararajan, S.; Viswanathan, G. (Bharat Heavy Electricals Ltd., Tiruchirapalli, India). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

Fluidized Bed Combustion offers an excellent potential for the utilization of poor quality coal, coal washery middlings and rejects. Bharat Heavy Electricals Ltd. (BHEL) is actively engaged in the development of this technology and has already demonstrated commercial operation of over 14,000 hours at a 12 t/h unit. A second commercial unit of 45 t/h steaming capacity commissioned in October 1983 has logged over 4800 hours of operation. Contracts for the supply of a 10 MWe FBC boiler for captive power generation at a colliery (utilizing washery rejects containing 67% ash), a 35 t/h FBC boiler for bagasse, a 60 t/h FBC boiler and 2 hot has generators are underway. This paper elaborates the design philosophy developed by BHEL Tiruchy in designing a 30 MWe AFBC boiler. 9 figs., 2 tabs.

6932 (CONF-850297—, pp 108-126) **Coal water slurry combustion in fluid beds: prospects in India.** Nandakumar, K.; Sarma, P.V.L.N.; Malarkkan, K.M.V. (Bharat Heavy Electricals Ltd., Tiruchirapalli, India). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

Indian coals are predominantly high ash coals and their washability characteristics are very poor compared to North American or European coals. So, any coal wate slurry (CWS) system developed to gain the advantages like flexibility in handling and storage, minimum space requirements, etc., has to contend with higher ash. Fluidized bed combustion is suitable for high ash and low heat value fuels, and hence, CWS combustion in fluid beds has a combination of advantages. Combustion of medium ash CWS and washery tailings in fluid beds has been successfully researched in Canada, USA, Sweden, China, and Italy. In India and elsewhere, washery tailings have been posing pollution problems. BHEL, Trichy has already initiated testing of slurry fuels similar to washery tailings in their 0.5 x 0.5 m test rig. It is proposed to install a coarse (0 to 6 mm size) coal water slurry preparation and feeding system and conduct full fledged experiments for firing washery tailings and high ash CWS. India has about 2500 million tons of low ash, but high sulfur, bituminous coals. It is proposed that research on low ash CWS preparation and combustion can be done with Assam coals to start with, and can be on a wider scale with the advent of successful demineralization systems. 13 refs., 4 figs., 6 tabs.

6933 (CONF-850297—, pp 137-177) **Tennessee Valley Authority (TVA) involvement in the commercialization of atmospheric fluidized bed combustion (AFBC) for utility application.** Vincent, R.Q. (Tennessee Valley Authority, Chattanooga). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

Atmospheric fluidized bed combustion (AFBC) is a promising near-term alternative to conventional pulverized coal burning for the TVA power system. TVA's involvement in AFBC development began in 1974 and has addressed the major technical uncertainties through a comprehensive program of design, experimental, and analytical studies. A major milestone was reached in 1982 with the completion of a 20-MW AFBC pilot plant. This engineering pilot unit was designed to simulate utility power plant conditions and mechanical features. In 1988, a 160-MW AFBC Demonstration Plant will join the 20-MW Pilot Plant. Joint TVA/EPRI testing continues at the pilot plant with performance evaluations of large-scale AFBC components and systems, load control approaches, and coal feeding methods. The 160-MW demonstration unit will be operated in a controlled test program intended to fully commercialize AFBC for the utility industry.

6934 (CONF-850297—, pp 404-410) **CMERI programme on COM combustion and fluidized bed gasification of coal.** Datta, A.B. (Central Mechanical Engineering Research Institute, Durgapur, India). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

Without major modification of equipment running on oil or gas, use of coal oil mixture (COM) and gas from coal may provide an alternative source of energy. In this perspective, CMERI, Durgapur, has taken up two major projects: (1) Combustion of COM; and (2) Fluidized Bed Gasification of Coal. This paper briefly describes these programs.

6935 (CONF-8510182—2) **Char combustion kinetics of Kentucky No. 9 coal as applied to atmospheric fluidized bed combustion.** Daw, C.S.; Mitchell, R.E.; Byrd, J.R. (Oak Ridge National Lab., TN (USA); Sandia National Labs., Livermore, CA (USA); Tennessee Valley Authority, Knoxville (USA)). 1985. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003096.

From Fall meeting of the American Flame Research Committee; Livermore, CA, USA (17 Oct 1985).

Overall char burning rates were measured for Kentucky No. 9 coal and for char elutriated from the Tennessee Valley Authority 20 MW(e) Atmospheric Fluidized Pilot Plant while Kentucky No. 9 was being fed. Low-temperature burning rates (650 to 1100 K) were measured with a thermogravimetric analyzer at Oak Ridge National Laboratory, Oak Ridge, Tennessee. These data are compared with previous thermogravimetric data for Kentucky No. 9 and Ohio No. 6 coal and data from a fixed-sample, tubular-flow reactor at Oak Ridge. High-temperature experiments (1390 to 1600 K) were conducted in the entrained-flow reactor at Sandia National Laboratory, Livermore, California. These data are compared with the low-temperature results. It is concluded that the burning rate of Kentucky No. 9 char, exclusive of external mass-transfer effects, is best represented by two Arrhenius expressions, one applicable for low temperatures and another applicable for high temperatures. At temperatures typical of atmospheric fluidized bed combustion, the two expressions predict rates of similar magnitude. It is also concluded that the pilot plant elutriate is less reactive than Kentucky No. 9 coal at low temperatures. At high temperatures, the reactivity of the elutriate and coal appear to be nearly equal. 29 refs., 5 figs., 2 tabs.

6936 **(DOE/FE/60181—1869) Performance of low-rank coal in atmospheric fluidized bed combustion. Technology transfer report.** Hajicek, D.R.; Zobeck, B.J.; Mann, M.D.; Miller, B.G.; Ellman, R.C.; Benson, S.A.; Goblirsch, G.M.; Cooper, J.L.; Guillory, J.L.; Eklund, A.G. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Oct 1985. Contract FC21-83FE60181. 463p. NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE86003717.

This report presents test data generated at GFETC and discusses the implications of this data in regard to the technical and economic feasibility of using low-rank coals in the AFBC. Atmospheric fluidized bed combustion offers a number of potential advantages over conventional pulverized coal combustion due to the intense turbulence in the fluidized bed and long residence times of solids in the bed without a long linear flow path. Advantages of the AFBC include flexibility to handle varying fuels, sulfur capture by limestone, high combustion efficiency, compact combustor size, lower NO/sub x/ emissions, and reduced slagging and fouling problems. Low-rank coals with high alkali-to-sulfur ratios offer a significant additional advantage: the ability to absorb significant sulfur on the alkaline ash. Results verify that AFBC is particularly well suited for the direct combustion of low-rank coals. With combustion temperatures above 1450°F at 20% excess air or higher, the combustion efficiencies while burning low-rank coal were found to be above 98%, with efficiencies above 99% for most tests. The CO emissions were very low, typically below 0.05 lb/MMBtu or 50 ppMv. Overall heat transfer coefficients to water-cooled tubes while burning low-rank coals were comparable to those obtained with other fuels in AFBC, or 20 to 60 Btu/h-ft^2-°F. These are considerably higher than those obtained in conventional coal-fired systems which are typically 5 to 15 Btu/h-ft^2-°F. Factors influencing heat transfer included mass velocity, bed particle size, bed temperature, and ash recycle.

6937 (DOE/METC—85/6021-Vol.2, pp 1075-1084) **Combustion and emission characteristics of gob pile wastes in fluidized-bed combustors.** Rajan, S.; Taylor, E.W. (Southern Illinois Univ., Carbondale). Jul 1985. NTIS, PC A24/MF A01. File Number DE85013689. (CONF-850302—Vol.2).

From 8. international conference on fluidized bed combustion; Houston, TX, USA (18 Mar 1985).

Investigations in the US and other countries in the last few years have shown that the fluidized bed combustion process lends itself easily to the utilization of coal washery rejects, mine tailings and other low heating value fuels. Of particular interest to countries mining large quantities of coal are gob pile wastes and mine tailings which potentially represent large amounts of energy, but if unused remain as environmental eyesores. The purpose of this paper is to evaluate the behavior of gob pile wastes and mine tailings in a bench scale fluidized bed combustor. Selected low heating value gob pile wastes were analyzed with reference to elemental composition and sulfur forms. The coals were size graded and burnt in the combustor under varying conditions of fluidization, bed temperature, size fractions, etc. Data on the combustion and emissions behavior of the gob coal are presented. 14 references, 7 figures, 1 table.

6938 (DOE/METC—85/6021-Vol.2, pp 564-573) **Operational evaluation of the Great Lakes fluidized-bed demonstration plant.** Dooley, M.J.; Vroom, H.H. (CE Power Systems, Windsor, CT). Jul 1985. NTIS, PC A24/MF A01. File Number DE85013689. (CONF-850302—Vol.2).

From 8. international conference on fluidized bed combustion; Houston, TX, USA (18 Mar 1985).

A summary of the operational and performance experience at the Great Lakes facility is presented. An analysis of the performance test results describes the effects of various operating parameters on boiler performance. The operational evaluation includes start-up procedures and transient response. Transient response covers the boiler load following capabilities. Boiler response to emergency conditions, such as loss of power and loss of fuel, were investigated. A presentation is given of the tube erosion study and how this is being incorporated into bed surface design. The relationship of tube configuration and orientation to erosion rates is analyzed. Included in the analysis of the performance testing is a comparison of the effect of the major parameters, such as calcium to sulfur mole ratio, excess air, and recycle feed rate, on the overall boiler performance. The boiler performance aspects studied include environmental emissions as well as combustion efficiency and boiler efficiency. 4 references, 10 figures.

6939 **(DOE/PC/40804—T12) Measurement of solids motion in gas fluidized beds. Final progress report, September 1, 1981-December 31, 1984.** Chen, M.M.; Chao, B.T. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). Nov 1985. Contract FG22-81PC40804. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003579.

A quantitative investigation of solids and bubble motion in gas fluidized beds has been conducted through the use of the Computer-Aided Particle Tracking Facility (CAPTF). Particle motion as influenced by bed geometry, particle size, particle density and shape, distribution of solids feeders and withdrawal lines, gas distributors design, configuration of internals, and operating conditions has been investigated. The CAPTF permits the continuous, automatic tracking of a radioactive tracer particle which is dynamically identical to the particles under investigation. This report describes this facility, as well as the investigation and the application of the facility to it. 22 refs. (PLG)

6940 **(DOE/PC/50266—11-12) Vaporization and devolatilization of coal water sprays eleventh and twelfth quarterly reports for the periods ending May 11, 1985 and August 11, 1985.** Chigier, N.; Meyer, P.L. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Mechanical Engineering). 1985. Contract FG22-82PC50266. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86003072.

The effects of varying air/fuel ratios on the performance of two Parker Hannifin atomizers were studied. Slurry flow rates were varied from 200 to 400 to 600 lb/hr and the air/fuel ratio varied from 0.3 to 1.2. Malvern measurements were made at a location five inches downstream from the atomizer tip. These studies showed that obscuration increased with increasing air/fuel ratio. Above an air/fuel ratio of 0.6, there was little change in obscuration, D_{32} or weight distribution, indicating that additional atomizing air has little effect. Significant differences in weight distributions and in mean and median diameters were obtained depending on whether Rosin Rammler or Model Independent data fitting routines were used. It was only appropriate to use the Rosin Rammler program to fit the data at high air/fuel ratios. At low air/fuel ratios, the bulk of the spray distribution occurred in the upper size bands. The Model Independent program was required to fit the data. We recommend that the user scan the range of conditions to be studied using the Model Independent program. For cases where the sample weight is concentrated in the center of the Malvern's size bands, Rosin Rammler may be appropriate. It is not appropriate to use the Rosin Rammler program in the initial scan of the conditions since it forces the data to fit a monomodal distribution. 21 refs., 28 figs., 5 tabs.

6941 **(DOE/PC/70770—5) Fundamental studies of the mechanisms of slag deposit formation, June 1, 1985-August 31, 1985.** Austin, L.G.; Tangsathitkulchai, M.; Gomez, C.; Benson, S. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). Sep 1985. Contract FG22-84PC70770. 51p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86003640.

An electrical resistance drop tube furnace was assembled which is similar in design and principle to the gas-fired furnace. This furnace has a maximum temperature of 1550°C, whereas the gas-fired furnace enables tests to be performed up to 1700°C. A smaller electrical resistance furnace has been designed to be attached to the base of the new drop tube furnace. This will be used to give increased particle residence time during the cooling period from maximum flame temperature to the temperature of deposition. It is considered essential to test the effect of this variable before proceeding with a systematic study of the other variables. A means of determining deposit strength and adhesion on both a micro- and macro-scale was devised. The instrument consists of a horizontal translator and pressure transducer. The test probe is driven against the deposit at a controlled speed, and the force required to shear or crush the deposit is measured by the transducer. Preliminary results

of strength measurements performed on a Rosebud slag deposit (from Rosebud sub-bituminous coal) indicated crushing strengths ranging from 1200 psi at the base to 4000 psi at the top of the deposit. Sintering experiments were conducted using a mineral mixture that simulated the composition of the inorganic constituents of Upper Freeport bituminous coal. The experiments were conducted in both oxidizing and reducing atmospheres. The results suggest that the sintering mechanism occurs by viscous flow of a liquid phase for both the mineral mixture and the Upper Freeport fly ash.

6942 **(EPRI-AP—4291) Determination of autoignition and flame speed characteristics of coal gases having medium heating values. Final report.** Peschke, W.T. (United Technologies Research Center, East Hartford, CT (USA)). Nov 1985. 73p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920057.

This experimental research program was directed toward developing spontaneous ignition and flame propagation data for application in the design of utility gas turbines burning Medium Heating Value (MHV) coal gas premixed (before entry to the combustor) with air. Specifically, an existing continuous-flow apparatus was used to measure ignition delay times directly for several gas compositions. A modification of that apparatus enabled the measurement of turbulent flame speed at elevated pressure and temperature and under conditions of turbulence encountered in gas turbine combustors. The ignition delay characteristics of MHV coal gases were measured over a range of pressures from 12 to 25 atm, inlet air temperatures up to 811 K and various fuel-air equivalence ratios. Turbulent flame speed data were acquired over a range of pressures from 5 to 8 atm, flow velocities from 20 to 40 m/sec and turbulence intensities from 0.12 to 0.20. The results of the ignition delay tests indicate that the MHV coal gases tested exhibit spontaneous ignition characteristics that are similar to hydrogen (a major constituent of the gas) and that the gas's ignition delay depends primarily on temperature. Pressure and fuel-air equivalence ratio variations affect the ignition delay to a lesser extent.

0150 MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 7356

6943 **(DOE/FE/60294—T1) Summary of coal export project.** (Southern States Energy Board, Atlanta, GA (USA)). Jan 1984. Contract FG01-83FE60294. 244p. NTIS, PC A11. File Number DE86003773.

Through its series of international coal conferences, public policy symposia and related activities, SSEB has called attention to the problems and prospects of the US coal industry in foreign markets. The series of dialogues between US and European representatives has provided an excellent forum for the frank discussion of impediments to the export of US coal. If coal is to achieve the vast potential that it holds for the South's economy, every effort must be made to promote this critical energy resource aggressively. US coal exports are expected to grow in the next ten years with most of the growth in the steam coal market. The high value of the US dollar, increased competition, expanded port capacity in other coal producing countries, and limited growth in demand for coal continues to limit the demand for US coal exports. These limiting factors suggest the US will remain the swing supplier of coal on the world market in the foreseeable future. The overall purpose of the US-European coal dialogue has been to delineate barriers to the export of US coal, and to foster a bilateral commitment to alleviate these impediments. A number of SSEB meetings with European coal representatives have resulted in firm commitments by all parties to examine solutions to these problems.

0160 HEALTH AND SAFETY

6944 **(PNL-SA—13178) Health risks resulting from coal-liquefaction industry atmospheric discharges.** Mellinger, P.J. (Pacific Northwest Labs., Richland, WA (USA)). Sep 1985. Contract AC06-76RL01830. 20p. (CONF-851160—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003558.

From Air Pollution Control Association Pacific Northwest international section annual meeting; Calgary, Canada (13 Nov 1985).

Potential human health effects from inhalation of nonmethane hydrocarbons (NMHC) that may be released from a future hypothetical industry producing about 600,000 bbl/day of synthetic fuel by direct liquefaction of coal are estimated. General assumptions are refined in a tiered sequence that considers available environmental, chemical, and epidemiological data. Surrogate health effects data bases considered for use in estimating potential health effects from a coal-liquefaction industry include coke oven, British gas retort, roofing tar and asphalts, and cigarette smoke. The coke-oven data base was selected for this assessment, because the chemical and physical nature of coke-oven emissions is judged to more closely approximate potential coal-liquefaction emissions than those from the other industries. In addition, there is an extensive epidemiological data base for coke-oven workers that can be used to provide the basis for estimating health effects from biological studies from coal-liquefaction NMHC.

02 PETROLEUM

0203 DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 7843

6945 **(DOE/MC/12010—T3) Numerical modelling committee NTS experiments. Interim report.** Fourney, W.L.; Holloway, D.C.; Barker, D.B. (Maryland Univ., College Park (USA). Photomechanics Lab.). Oct 1979. Contract AC21-79MC12010. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003437.

Tests conducted in three dimensional blocks of plexiglass with 200 to 250 mg of PETN located in a column configuration at the bottom of a stemmed 250 mm borehole have suggested a new technique for well stimulation. The predominant fracture in these blocks originated at the base of the stemmed area where gas pressure and duration were found to be more than twice those in the center borehole region. In view of these results it may be worthwhile to consider the investigation of this phenomenon in the upcoming NTS experiments. 6 figs.

6946 **(DOE/SF/01424—48-1) Multi-pattern low-tension demonstration flood, Big Muddy field. Technical progress report, July-September 1985.** Mosley, M.K. (Conoco, Inc., Casper, WY (USA)). 1985. Contract AC03-78SF01424. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003461.

The injection of the polymer-pusher slug was terminated September 27, 1985. A polymer taper was initiated August 1, 1985, by reducing the viscosity from 12 cp. to 6 cp. A further reduction to 4 cp. was made August 20, 1985. Overall, a total of 1,519,000 barrels of polymer-pusher slug was injected, beginning August 10, 1982, and ending September 27, 1985. Project injection was 1032 BPD in September, up from 791 BPD in July as the rate was intentionally increased during the polymer taper. Also, injection was no longer maintained below a pressure-parting condition. July and August production were 88 BOPD and 86 BOPD, respectively. Oil production for September was high by 255 barrels of oil as accumulated bad oil in treating tank T-15 was finally treated and sold. Oil sales for September averaged 100 BOPD; actual production was estimated at 91 BOPD. Cumulative project production was 233,571 barrels of oil as of September 30, 1985 (sales only). 6 figs., 4 tabs.

6947 **A theory for the most stable variable viscosity profile in graded mobility displacement processes.** Gorell, S.B.; Homsy, G.M. (Stanford Univ., Stanford, CA). *AIChE (American Institute of Chemical Engineers) Journal;* **31**: No. 9, 1498-1503(Sep 1985).

The stability of the displacement of a viscous fluid in a porous medium by a less viscous fluid containing an additive is considered. For the case in which the total amount of injected additive is fixed, a theory has been formulated to find the graded mobility profile which minimizes the instability due to an adverse mobility

ratio. The result is a constrained nonlinear eigenvalue problem in which the mobility ratio of the fluids, α, and the total dimensionless amount of additive, N, appear as parameters. Estimates show N is typically large for practical situations. An asymptotic solution for large N is developed which shows that the optimal mobility profile is always an exponential curve at leading order. It is shown that although the optimal mobility profile is nearly exponential, the optimal concentration profile is not necessarily so, contrary to previous suggestions in the literature. Furthermore, it is shown that, unlike the case of a mobility jump, a graded mobility process under optimal conditions has amplifications independent of displacement velocity. We also discuss a possible stabilization mechanism due to the very long wavelength disturbances which occur under optimal conditions.

0204 PROCESSING

REFER ALSO TO CITATION(S) 6906

0205 PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 6955

0207 MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 7356

6948 **(DOE/EI/19691—T1) End of survey report. Prices/stocks of No. 2 heating oil. State of Oregon, 1984-1985.** (Computer Resource Application Group, Portland, OR (USA)). 1985. Contract FG01-84EI19691. 36p. NTIS, PC A03. File Number DE86003844.

The results of surveys on the prices of No. 2 heating oils and end-of-the-month stock-in-inventory from October 1, 1984 through May 1, 1985 are presented. Twenty firms were reviewed during the course of the survey period. Participating companies were located primarily within The Williamette Valley in Oregon. This year's survey, produced almost no surprises nor aspects that would be considered of any real significance. Despite a record setting dry winter with accompanying lower temperatures, the continued low economic activity throughout the state and various conservation measures resulted in a seemingly steady but low demand. Inventories varied little during the season and fell off as the season ended. The industry appears to be fairly stable with almost no changes reported in ownership, activity, or mergers. This is the only significant variation from the surveys conducted in the state since the 1979-1980 season.

6949 **(DOE/EIA—0109(85/09)) Petroleum Supply Monthly, September 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 22 Nov 1985. 105p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. File Number DE86003803.

US supply, disposition and stocks of crude oil and petroleum products are reported for each year from 1973 through 1985, with monthly data given for the most recent 3 years. Detailed statistics are given for the most recent month available. Shown are: supply and disposition for the US and each Petroleum Administration for Defense (PAD) District; production of crude oil and lease condensate by State and PAD District; natural gas processing plant production by PAD District; refinery operations by PAD District; imports and exports of crude oil and petroleum products; stocks of crude oil and products by PAD District; transportation between PAD Districts; and heavy fuel oils by sulfur content. A glossary, maps of various Districts, and explanatory notes discussing the data collection methodology are included. This issue contains an article on the comparison of independent statistics on petroleum supply. 13 figs., 33 tabs.

6950 **(DOE/EIA—0380(85/09)) Petroleum Marketing Monthly, September 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 29 Nov 1985. 156p. NTIS, PC A08/MF A01; 1 - GPO; GPO Dep. File Number DE86003956.

Preliminary data for September 1985 indicate that refiners' crude oil acquisition costs are continuing to decline slowly. The decline in both domestic and imported refiners' crude costs resulted in a drop in the composite acquisition cost of 6 center per barrel (0.2%). In the petroleum products markets, preliminary data (summarized in the table below) show that total refiner/gas plant operator sales of selected petroleum products declined 2.7% from the August sales level. While sales of motor gasoline, residual fuel oil, aviation gasoline, and No. 2 diesel were down in September, sales of No. 2 fuel oil, kerosene, No. 1 distillate, No. 4 fuel oil, and propane showed seasonal increases. In addition, sales of kerosene-type jet fuel rose up slightly. Refiner/gas plant operator prices rose in September for most petroleum products at the retail and wholesale levels. At the retail level, the three grades of motor gasoline were the only products showing price decreases. At the wholesale level, prices of motor gasoline and aviation gasoline declined. Wholesale prices for all the other products increased in September, with the No. 2 distillate price up 4.4 cents per gallon. The September petroleum marketing activity is summarized. 17 figs., 75 tabs.

6951 **(LSU/CES—85-W-03) Protectionism and the US refining industry.** Brossard, E.B. (Louisiana State Univ., Baton Rouge (USA). Center for Energy Studies). 1985. 71p. NTIS, PC A04/MF A01. File Number DE86900267.

Almost unnoticed in the US press is the entrance of the US in the international market as a major exporter of oil products. The author describes his views on protective tariffs particularly with regard to the US refinery industry. He concludes that the new demands for protectionism by some refiners, if enacted into legislation by Congress, would not only raise the cost to all energy consumers but would also adversely affect US American industry, commencing with US exporting refiners that have recently entered the international products market. There would be retaliation by other countries and massive defaults by countries like Mexico. It is not in the national interest for the US to engage in oil tariffs or quotas that may harm the economies of our friendly trading partners - partners upon whom the US is dependent for one-third of its oil consumption and whom the US will need in time of crisis. Discussed are the US oil industry, OPEC, Venezuela, shutdowns, modernization, exports, imports, spot market, Western European refiners, and internationalization vs protectionism. 19 tabs. (DMC)

0208 WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 7403, 7596

0230 PROPERTIES

REFER ALSO TO CITATION(S) 7541

6952 **(CONF-851027—5) Comparative chemical characterization of shale oil- and petroleum-derived diesel fuels.** Griest, W.H.; Higgins, C.E.; Guerin, M.R. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003310.

From Health and environmental research on complex organic mixtures; Richland, WA, USA (21 Oct 1985).

The Department of Defense is concerned with determining if a changeover from petroleum- to shale oil-derived mobility fuels would be accompanied by a significantly different toxicological hazard. To address this issue, we are conducting a toxicological comparison of diesel fuels derived from shale oil and petroleum. Dermal and inhalation toxicology are current primary concern. This paper presents the current results of comparative chemical analyses of the fuels. A set of 11 diesel fuels representing industrial reference, military referee, military-purchased petroleum-derived diesel fuels, and two fuels from different shale oil retorting and refining operations, and a fuel from tar sands/petroleum coprocessing is being characterized. High resolution GC analysis of both the bulk fuels and their headspace vapor quantifies major components and generates "fingerprints" for relative compositional comparison. All the fuels share the same set of major components, consisting of Cg through C_{21} n-paraffins at levels of 1 to 29 mg/g each. In addi-

tion, branched hydrocarbons, di- and triaromatic hydrocarbons are visualized. The inhalable vapors from the fuels consist mainly of C_2-C_{10} hydrocarbons. Consistent differences between shale oil- and petroleum-derived diesel fuels as groups have been observed for minor components (ca. <1 mg/g each) in both the fuels and their inhalable vapors. In addition, individual fuels within each group can be distinguished. Separate measurements of benzene (<0.01-0.08 mg/g) and C_1-C_4 alkyl benzenes (generally 0.3-1 mg/g) show similar levels in the two sets of fuels. The benzo (a) pyrene levels in two shale oil-derived diesel fuels (0.03 and 0.09 μg/g) fall within the range observed for petroleum-derived diesel fuels, although the highest concentration (0.84 μg/g) was found in a darkly colored petroleum-derived DF-2. 15 refs., 2 figs., 4 tabs.

6953 (DOE/ER/60043—T2) Determination of PAH in SRM 1582, Wilmington crude oil. (National Bureau of Standards, Washington, DC (USA)). 13 Dec 1982. Contract AT01-82ER60043. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003692.

The concentrations of phenanthrene, fluoranthene, pyrene, benz(a)anthracene, benzo(a)pyrene, and perylene have been measured in SRM 1582 using the sequential HPLC procedure that was used in the certification PAH in SRM 1580, "Organics in Shale Oil". Quantification was accomplished through use of perdeuterated internal standards which were spiked into the oil sample at concentrations similar to that of the analyte compounds. The instrumentation used in these analyses is listed in Table I. The internal standard used for each analyte is identified in Table II. Perdeuterated analogs of the parent PAH serve as excellent internal standards because they have the same number of aromatic carbons and therefore co-elute on the aminosilane column. The perdeuterated PAH compound is resolved chromatographically from the parent PAH compound on the C_{18} column, with the internal standard eluting just prior to the parent. The perdeuterated and parent compounds have similar fluorescence excitation and emission spectra as shown by the fact that their relative response factors are close to unity. Calibration solutions containing both the internal standard and analyte compounds were prepared for each compound to be determined. The concentration of the analyte compound in these solutions was routinely verified by comparison with SRM 1647. 1 ref., 8 tabs.

6954 (DOE/ER/60043—T3) Determination of dibenzothiophene in SRM 1582, Wilmington crude oil and addendum. (National Bureau of Standards, Washington, DC (USA)). 7 Sep 1982. Contract AT01-82ER60043. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003691.

The concentration of dibenzothiophene (DBTP) in SRM 1582 has been measured for eight samples using the standard technique in conjunction with a sulfur-specific dual-flame photometric detector (FPD) operating in the normal mode. The response of the FPD is not linear with the concentration of sulfur-containing compounds, but approximately with the square root of the response. The exact power of the response (linearization exponent) which is linear with concentration depends not only on the type of sulfur compound measured, but also to some extent on daily changes in the gas chromatographic instrument, such as slight changes in the flow of air, hydrogen or carrier gases, temperature changes, and detector geometry. In order to avoid these changes being possible sources of error and to determine the correct linearization exponent, detector calibration runs similar to the sample runs were performed on the day of analysis. Moreover, interfering peaks around the dibenzothiophene dictated that some sort of sample clean-up was necessary. To this end, the oil sample was first fractionated on a liquid chromatograph (LC), then concentrated prior to gas chromatographic analysis.

6955 (DOE/PC/60807—8) Supercritical fluid chromatography/supersonic jet spectroscopy. Progress report, August 1-October 31, 1985. Lee, M.L.; Goates, S.R. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry). 1985. Contract FG22-83PC60807. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003740.

During this period, efforts were continued to optimize the detection systems on the supercritical fluid fractionation apparatus. Experiments were conducted to improve the performance of the UV detector system. Fractionation of Wyoming Recluse Crude Oil was completed and the capillary gas chromatograms of some fractions collected during supercritical fluid fractionation of this crude oil are presented. Chemical class fractionation studies continued during this period with the evaluation of underivatized silica as a stationary phase for the separation of aliphatics from aromatics in gasoline range samples. Testing has been completed on the optical systems for steering and focusing of the laser beam and collection of the fluorescence signal. Investigation of aerosol formation in the expansion of supercritical fluids is almost complete. 10 figs., 1 tab. (PLG)

0240 STORAGE

6956 (SAND—85-1331) Separate effects evaluation for the Strategic Petroleum Reserve thermal model. Tomasko, D. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1985. Contract AC04-76DP00789. 120p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86004235.

Sensitivity studies were performed for the Sandia Strategic Petroleum Reserve (SPR) thermal model. Analyses of the results obtained indicate that the following models are essential for correct temperature prediction: a counter-flow heat exchanger model, a mixing model, and a model for interfacial heat transfer between the saturated brine and the cavern crude oil. The thermal model was found to be fairly insensitive to the boundary conditions used at the extremities of the calculational mesh, as well as to enhanced heat transfer at the bottom of the cavern due to convection across the SPR porous media. The thermal calculations were most sensitive to variations in the thermal conductivity of the surrounding salt and the initial temperatures of the fluid in the caverns. Effects caused by uncertainties in the initial temperature of the brine were reduced by using a thermal log performed near the onset of oil fill. 7 refs., 88 figs., 4 tabs.

0250 COMBUSTION

6957 (BNL—51810) Evaluation of the low temperature heat exchanger fouling problem. Results of studies on soot production and condensing system fouling. Butcher, T.; Celebi, Y.; Piraino, M. (Brookhaven National Lab., Upton, NY (USA)). Jun 1984. Contract AC02-76CH00016. 92p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86004083.

The development of condensing heat exchangers for oil-fired heating equipment would yield a significant improvement in thermal efficiency. Soot production by oil burners, however, could lead to serious fouling problems in these systems. The objectives of this study were to investigate the causes of fouling in oil-fired condensing systems and to evaluate the need for the development of advanced oil burners. Tests were done to evaluate the effect of operating conditions on start-up and shutdown smoke production in both noncondensing and condensing furnaces. Modern retention head burners which are commonly used in the US were included as well as one European burner with some different design features. These features included the head design, a fuel shut-off in the nozzle tip, and nozzle heating. This burner was found to produce less smoke on start-up and shutdown than the common US burner. Fouling studies were done on both types of burners under cyclic conditions with relatively low excess air (10% CO_2) and continuous induced draft. Soot deposition did not cause any change in system thermal performance although soot deposition was heavier than would be expected with a noncondensing system. Tests were also done on the effects of fuel quality on soot production. Measurement techniques for soot included the common Bacharach smoke spot test, optical opacity, and filtration (EPA method 5). 27 refs., 69 figs., 18 tabs.

03 NATURAL GAS

REFER ALSO TO CITATION(S) 7426

0302 GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 6961

6958 **(SAND—85-2398C) Multiwell experiment site geology, October 1, 1984-September 30, 1985.** Lorenz, J.C. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 7p. (CONF-8511111—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003241.

From Unconventional gas recovery contractors' meeting; Morgantown, WV, USA (18 Nov 1985).

The objective of the site geology study for the Multiwell Experiment project is the detailed geologic characterization of the Mesaverde low-permeability reservoirs. This characterization includes obtaining data on the external morphology (size, shape, and orientation) of the reservoirs penetrated by the MWX wells so that reservoir volumes and interactions with both natural and hydraulic fractures could be assessed; and the internal characteristics of the reservoirs (distribution of permeability barriers and fractures), so that reservoir production behavior could be properly modeled. Background statement, project description, results and evaluation of potential future plans are presented. 11 refs., 4 figs.

0303 DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 6947

6959 **(DOE/MC/14521—1961) Estimating the gas drainage patterns of western tight sand reservoirs.** Hancock, J.S. (EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)). Mar 1983. Contract AC21-81MC14521. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001010.

This document describes a method of estimating the gas drainage patterns of tight sandstone gas reservoirs. The method allows the placement of gas wells within a reservoir so that the likelihood of wells competing for the available gas is minimized. 4 refs., 11 figs., 7 tabs.

0306 MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 7356

6960 **(DOE/EIA—0130(85/09)) Natural Gas Monthly.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Sep 1985. 173p. NTIS, PC A08/MF A01; 1 - GPO; GPO Dep. File Number DE86003613.

Current data on natural and supplemental gas consumption, disposition, production, prices, storage, imports, and exports in the United States are provided for each year from 1980 through 1985 with monthly data for the most recent 3 years. Some data are also given by State or city, some data are also given for previous years. Operating and financial data for major interstate natural gas pipeline companies as well as data on filings, ceiling prices, and transportation under the Natural Gas Policy Act of 1978, are also included. Explanatory notes, a discussion of data sources, and a glossary are included. Three reports previously published as separate annuals are now published in this report. The three are: "Underground Natural Gas Storage in the United States" (DOE/EIA-0239); "US Imports and Exports of Natural Gas" (DOE/EIA-0188); and "Main Line Sales of Natural Gas to Industrial Users" (DOE/EIA-0129). Featured article for this issue is "Residential and Commercial Natural Gas Markets." 6 figs., 33 tabs.

0309 ARTIFICIAL STIMULATION

REFER ALSO TO CITATION(S) 6945

6961 **(SAND—85-2396C) Multiwell experiment.** Sattler, A.R.; Warpinski, N.R.; Lorenz, J.C.; Hart, C.M.; Branagan, P.T. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 7p. (CONF-8511111—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003240.

From Unconventional gas recovery contractors' meeting; Morgantown, WV, USA (18 Nov 1985).

The Multiwell Experiment is a research-oriented field laboratory. Its overall objectives are to characterize lenticular, low-permeability gas reservoirs and to develop technology for their production. This field laboratory has been established at a site in the east-central Piceance basin, Colorado. Here the Mesaverde formation lies at a depth of 4000 to 8250 ft. This interval contains different, distinct reservoir types depending upon their depositional environments. These different zones serve as the focus of the various testing and stimulation programs. Field work began in late 1981 and is scheduled through mid-1988. One key to the Multiwell Experiment is three closely spaced wells. Core, log, well testing, and well-to-well seismic data are providing a far better definition of the geological setting than has been available previously. The closely spaced wells also allow interference and tracer tests to obtain in situ reservoir parameters. The vertical variation of in situ stress throughout the intervals of interest is being measured. A series of stimulation experiments is being conducted in one well and the other two wells are being used as observation wells for improved fracture diagnostics and well testing. Another key to achieving the Multiwell Experiment objectives is the synergism resulting from a broad spectrum of activities: geophysical surveys, sedimentological studies, core and log analyses, well testing, in situ stress determination, stimulation, fracture diagnostics, and reservoir analyses. The results from the various activities will define the reservoir and the hydraulic fracture. These, in turn, define the net pay stimulated: the intersection of a hydraulic fracture of known geometry with a reservoir of known morphology and properties. Accomplishments of the past year are listed. 4 refs.

6962 **(SAND—85-2397C) High energy gas fracture research.** Cuderman, J.F. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 5p. (CONF-8511111—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003239.

From Unconventional gas recovery contractors' meeting; Morgantown, WV, USA (18 Nov 1985).

The objective of high energy gas fracture (HEGF) research is to develop fracture techniques for application in gas well stimulation. This is done using propellants whose burn rates can be tailored for specific applications. Previous research successfully developed technology for multiple fracturing liquid-free, uncased wellbores and applied it to gas wells in Devonian shale. Current efforts are directed toward developing HEGF for stimulating wells which are cased and perforated, both with and without liquid present. Results are discussed. 5 refs.

6963 **(SAND—85-2399C) Multiwell fracturing experiments.** Warpinski, N. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 7p. (CONF-8511111—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003236.

From Unconventional gas recovery contractors' meeting; Morgantown, WV, USA (18 Nov 1985).

The objective of the Multiwell fracturing experiments is to test and develop the technology for the efficient stimulation of tight, lenticular gas sands. This requires basic understanding of: (1) fracture behavior and geometry in this complex lithologic environment, and (2) subsequent production into the created fracture. The intricate interplay of the hydraulic fracture with the lens geometry, the internal reservoir characteristics (fractures, reservoir breaks, etc.), the in situ stresses, and the mechanical defects (fracture, bedding, etc.) need to be defined in order to develop a successful stimulation program. The stimulation phase of the Multiwell Experi-

ment is concerned with: (1) determining important rock/reservoir properties that influence or control fracture geometry and behavior, (2) designing fracture treatments to achieve a desired size and objectives, and (3) conducting post-treatment analyses to evaluate the effectiveness of the treatment. Background statement, project description, results and evaluation of future plans are presented. 5 refs., 2 figs., 2 tabs.

6964 (SAND—85-2400C) Mineback Stimulation Research Experiments. Warpinski, N.R. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 5p. (CONF-8511111—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003237.

From Unconventional gas recovery contractors' meeting; Morgantown, WV, USA (18 Nov 1985).

The objective of the Mineback Stimulation Research Experiments is to improve hydraulic fracture stimulation technology by providing an in situ laboratory where basic processes and mechanisms that control and influence fracture propagation can be observed, measured and understood. While previous tests have been instrumental in providing an understanding of the mechanisms controlling fracture height, current experiments are focused on fluid flow through the created fracture and the associated pressure drops and crack widths. Work performed, accomplishments and future plans are presented. 7 refs., 2 figs.

6965 (SAND—85-2401C) Multiwell Experiment: fracture diagnostics. Hart, C.M. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 5p. (CONF-8511111—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003238.

From Unconventional gas recovery contractors' meeting; Morgantown, WV, USA (18 Nov 1985).

The objective of the fracture diagnostics program is to develop and demonstrate an integrated instrumentation system for measuring hydraulic fracture geometry. The principal product of this development program will be a set of interlinked instrumentation systems which, collectively, provides information regarding fracture orientation, length, height, and width. The Multiwell Experiment provides the medium for demonstration of the developing technology. Project description, results and evaluation of potential future work are presented. 5 refs.

0320 TRANSPORT, PIPELINES, AND HANDLING

6966 (DOE/EIA—0167(84)) Gas supplies of interstate natural gas pipeline companies, 1984. Price, R. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 4 Dec 1985. 132p. NTIS, PC A07/MF A01; 1 - GPO; GPO Dep. File Number DE86004078.

This publication provides information on the total reserves, production, and deliverability capabilities of 89 interstate pipeline companies. The gas supplies of interstate pipeline companies consist of the certificated, dedicated, recoverable, salable natural gas available from domestic in-the-ground reserves; gas purchased under contracts with other interstate pipeline companies; domestically produced coal gas, liquefied natural gas (LNG), and synthetic natural gas (SNG); and imported natural gas and LNG. The domestic in-the-ground reserves consist of company-owned reserves including natural gas in underground storage, reserves dedicated to or warranted under contracts with independent producers, and supplemental or short-term supplies purchased from independent producers and intrastate pipeline companies. To avoid duplicate reporting of domestic in-the-ground reserves, the volumes of gas under contract agreement between jurisdictional pipelines have been excluded in summarizing state and national reserves. Volumes contracted under agreements with foreign suppliers include pipeline imports from Canada and Mexico and LNG from Algeria. 8 figs., 18 tabs.

04 OIL SHALES AND TAR SANDS

0404 OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 6906

6967 (CONF-850297—, pp 202-246) Gas cleanup: a review. Vaidyeswaran, R. (Regional Research Lab., Hyderabad, India). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

An overview of hot gas cleanup processes are presented. Hot has cleanup for removal of particulate matter, sulphur compounds, CO_2, etc., which are harmful to gas turbines and to catalysts for subsequent processing, is of great interest in the coal conversion process, and is being extensively studied. These studies involve adsorption, chemical reaction with metal oxides, complexes, etc., membrane separation, and other novel techniques. It is proposed to try some of these on bench scale using a simulated gas mixture, and later the gas from the moving bed gasifier at RRL-H. 5 refs., 1 tab.

6968 (DOE/FE/60177—1955) Vacuum pyrolysis of sodium stearate. Chong, S.L. (Western Research Inst., Laramie, WY (USA)). Sep 1985. Contract FC21-83FE60177. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002050.

Vacuum pyrolysis of sodium stearate was studied to provide useful information for Green River oil shale pyrolysis. Sodium stearate is a typical compound of carboxylic acid salts amounting to 3.6% of total organic materials in the oil shale by methanol extraction. Sodium stearate contained in a stainless steel miniature reactor was heated at 450°C in a fluidized sand bath. Pyrolysis times ranged from 15 to 120 minutes. The amounts of gas and liquid products were measured and composition determined by gas chromatography. Ethane, methane, propylene plus propane, hydrogen, carbon dioxide, and carbon monoxide are the major gaseous products, in order of decreasing concentration. The predominant liquid product is a C_{17} alkene with C_{18}-C_{31} alkene/alkane pairs present. The first order decomposition rate constant for sodium stearate at 450°C was calculated to be 6.4×10^{-3} min.$^{-1}$. 18 refs., 7 figs.

6969 (DOE/FE/60177—1975) Technical and economic feasibility of sulfur trioxide retorting. Johnson, L.A.; Wing, E.E. (Western Research Inst., Laramie, WY (USA)). Oct 1985. Contract FC21-83FE60177. 39p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86003738.

A laboratory evaluation of oil shale retorting using sulfur trioxide injection has shown that sufficient heat is generated to retort oil shale. But the direct reaction of sulfur trioxide and oil shale results in large oil yield losses. A screening evaluation of the economic feasibility for sulfur trioxide retorting indicated that the large oil yield losses increase shale oil production costs relative to conventional retorting processes. Sulfur trioxide may be an economical alternative to air for oxidation of retorted shale in retorting processes using solid heat carriers. In this case, the shale is heated largely by the exothermic reaction of sulfur trioxide with the mineral carbonates in the shale. The hot retorted shale can be mixed with raw shale to isolate the oil and gas production from the sulfur trioxide reactions. A screening evaluation of this alternative use for sulfur trioxide indicates that the by-product credits for high Btu off-gas and CO_2 may offset the additional production costs for the sulfur trioxide. 11 refs., 7 figs., 12 tabs.

6970 (DOE/FE/60177—1976) Thermal degradation of shale oil on quartzite particles - preliminary experiments. Smith, E.B.; Nickerson, L.G.; Sullivan, S. (Western Research Inst., Laramie, WY (USA)). Dec 1985. Contract FC21-83FE60177. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003743.

Oil yields from oil shale retorts are usually less than predicted from Fischer assay, because oil is degraded by consumption,

cracking, and coking before it can escape the retort. Work is in progress at Western Research Institute (WRI) on determining rates of oil degradation by cracking and coking exclusive of combustion, under conditions similar to those in the preretorting zone of a retort. The experimental approach involves the introduction of shale oil downward into a bed of crushed quartzite packed in a tubular reactor. The reactor is heated to temperatures in the range of 400°F to 800°F, while preheated nitrogen flows upward through the tube. The reaction system is described in this report and results are presented of 10 preliminary experiments in which Paraho shale oil was degraded on quartzite particles at 400°F, 500°F, 600°F, and 700°F. Residence times for oil vapor were one to two seconds and for heavy (unvaporized) oil were 17 to 180 minutes. Recovery values varied from 85 to nearly 100 wt.%, and there was substantial loss of liquid products in the gas stream. Only trace quantities of light hydrocarbon gases were detected, indicating only a minor amount of cracking. It is concluded that there was little oil degradation in these experiments. It was also concluded that the operating procedure should be changed to achieve better product recovery and longer vapor residence times. 6 refs., 2 figs., 4 tabs.

6971 (DOE/FE/60177—1979) Final report on the use of gaseous tracers in WRI's 10-ton nonuniform oil shale retorting tests. Turner, T.F.; Moore, D.F. (Western Research Inst., Laramie, WY (USA)). Dec 1985. Contract FC21-83FE60177. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003880.

For tests on nonuniform oil shale retorting, Western Research Institute's 10-ton retort was loaded with shale rubble in zones of different permeability. The permeability of any given zone was determined by the particle size range loaded into that zone. The retort was studied using gas tracer techniques and flow model simulations. Results of these tracer studies are discussed in this report. Nine retorting and tracer runs were made on the retort. For each run, tracer injections were made into the main air flow inlet and into taps near the top of the retort. Detection taps were located at four levels in the retort with five taps on each level in tests S71 through S78 and six taps on each level in run S79. The oil shale rubble bed was configured with a cylindrical core in tests S71 through S78 and with two side-by-side regions with differing bed properties in test S79. Relationships are shown between the tracer response and sweep efficiency, oil yield, and local yield. Model simulations are compared with tracer responses and indicate fair agreement between model-estimated and measured response times but poor agreement on the shapes of the response curves. Although the data are scattered, there is suggestive evidence that the sweep efficiency of a retort can be determined using simple inlet-to-outlet tracer tests. Oil yield can also be predicted for the operating conditions used for the nonuniform retorting tests. More tests on retorts with intermediate degrees of nonuniformity must be made to confirm the correlations developed in this study. 15 refs., 9 figs.

0405 PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 6952

0410 ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 6920

05 NUCLEAR FUELS

0501 RESERVES

6972 (DOE/NBM—5018245) Supplemental testimony of John A. Patterson US Energy Research and Development Administration on Uranium Resources Availability. Patterson, J.A. (Puget Sound Power and Light Co., Bellevue, WA (USA)). 19 Jul 1977. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85018245.

This testimony reviews information available from the Energy Research and Development Administration (ERDA) on the domestic uranium-resource situation and the outlook for development of additional domestic supplies, availability of foreign uranium, and the relationship of uranium supply to planned nuclear generating capacity.

0502 EXPLORATION

REFER ALSO TO CITATION(S) 6972

6973 (SAND—83-2166) Status report of the multi-element logging project. Bivens, H.M.; Barnard, R.W.; Jensen, D.H.; Stephenson, W.A.; Weinlein, J.H. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1985. Contract AC04-76DP00789. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003440.

The multi-element logging project was an outgrowth of the PFN logging project, the objective of which was to make a direct assay of uranium. The objective of the multi-element logging probe project to determine the close proximity of uranium through the detection of elements which can be "pathfinder" elements associated with the deposition of uranium. Sandia National Laboratories built and evaluated a logging probe which incorporated a cooled, HPGe detector designed and built by EG and G-Ortec. This development model probe was used in several locations in the western US. The problems associated with the field use of the probe are described. The software used for the analysis of the gamma-ray spectra is summarized and reports describing the details of its design and use are referenced. 19 refs., 12 figs., 5 tabs.

0504 FEED PROCESSING

REFER ALSO TO CITATION(S) 7055

6974 (CONF-850242—10) Effects of barium chlorine treatment of uranium ore on ^{222}Rn emanation and ^{226}Ra leachability from mill tailings. Ibrahim, S.A.; Church, S.L.; Whicker, F.W. (Colorado State Univ., Fort Collins (USA). Dept. of Civil Engineering). 1985. Contract AC02-79EV10305. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003160.

From 7. symposium on management of uranium mill tailings, low-level waste and hazardous waste; Ft. Collins, CO, USA (6 Feb 1985).

The purpose of this laboratory study was to investigate the effectiveness of barium chloride treatment of uranium ore on ^{222}Rn emanation from mill tailings, ^{226}Ra level in waste-water, and the leachability of radium from tailings. It has been shown that barium sulfate is an excellent carrier for radium and that barium sulfate crystals have high retention capacity for radon gas produced by radium trapped within the lattice. Ground uranium ore from a mine in Wyoming was mixed with water to form a 1:1 ratio before barium and potassium chlorides were added at concentrations of 0, 10, 25, 50, and 100 mg per liter of slurry. The ore was then subjected to a simulated mill process using sulfuric acid leaching. The liquid representing tailings pond water was separated and analyzed for ^{226}Ra and the solid fraction, representing mill tailings, was tested for radon emanation and the leachability of radium by deionized water. This study suggests that barium treatment of uranium ore prior to sulfuric acid leaching could be effective in reducing radon emanation from tailings and also in reducing the ^{226}Ra concentration of waste-water. Leachability of radium from treated tailings was markedly reduced.

0505 ENRICHMENT

REFER ALSO TO CITATION(S) 7050

6975 (K/OA—5968) Finite element analysis of flow in a gas filled rotating annulus. Berger, M.H. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Sep 1985. Contract AC05-84OT21400. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86004009.

Linearized multi-dimensional flow in a gas centrifuge can be described away from the ends by Onsager's pancake equation.

However, a rotating annulus results in a slightly different set of boundary conditions than the usual symmetry conditions at the axis of rotation. In this process the problem on an annulus becomes ill-posed and requires some special attention. We treat linear inner and outer rotor temperature distributions and velocity slip. An existence condition for a class of nontrivial, one-dimensional solutions is given. New exact solutions in the infinite bowl approximation have been derived containing terms that are important at finite gap width and nonvanishing velocity slip. The usual one-dimensional axially symmetric solution is obtained as a limit. Our previously reported finite element algorithm has been extended to treat this new class of problems. Effects of gap width, temperature, and slip conditions are illustrated. We report on the compressible, finite length, circular Couette flow for the first time. 21 refs.

6976 **(K/TL—612) Evaluation of electroless nickel-plated stage control valve bearings.** Daugherty, C.E.; Petit, G.S. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 11 Feb 1977. Contract AC05-84OT21400. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003591.

Four electoless nickel-plated SKF-1308J stage control valve bearings installed in the Oak Ridge Gaseous Diffusion Plant (ORGDP) cascade as part of the Cascade Improvement Program (CIP) were removed in May 1976 for evaluation, after 1.5 y of service. Corrosion products located in and around the bearings were sampled for chemical analysis. The bearings were electroless nickel-plated in the Plating Development Laboratory of the Special Services Department before the bearing plating production process was installed by the Chemical Operations Division in March 1975. Three of the four bearings examined were in excellent condition after 1.5 y of service in the ORGDP cascade. Damage (estimated to cover about 1% of the area of each bearing) was found on the three bearings. There was no evidence of undermining of the plate in the damaged areas. The fourth bearing showed signs of lamination attributed to manual handling during the plating cycle. The equipment design incorporated into the K-1420 Bearing Plating Facility completely eliminates any handling during the plating operation.

6977 **(UCRL—93584) Atomic vapor laser isotope separation.** Stern, R.C.; Paisner, J.A. (Lawrence Livermore National Lab., CA (USA)). 8 Nov 1985. Contract W-7405-ENG-48. 56p. (CONF-851185—1). NTIS, PC A04/MF A01; GPO Dep. File Number DE86003491.

From International laser science conference; Dallas, TX, USA (18 Nov 1985).

Atomic vapor laser isotope separation (AVLIS) is a general and powerful technique. A major present application to the enrichment of uranium for light-water power reactor fuel has been under development for over 10 years. In June 1985 the Department of Energy announced the selection of AVLIS as the technology to meet the nation's future need for the internationally competitive production of uranium separative work. The economic basis for this decision is considered, with an indicated of the constraints placed on the process figures of merit and the process laser system. We then trace an atom through a generic AVLIS separator and give examples of the physical steps encountered, the models used to describe the process physics, the fundamental parameters involved, and the role of diagnostic laser measurements.

6978 **(K-Trans—53) Optimization of a gaseous diffusion plant for uranium enrichment.** Calori, F.; Scuricini, G.B.; Venditti, P. (Oak Ridge Gaseous Diffusion Plant, TN (USA); Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). [1985]. Contract AC05-84OT21400. Translation of RT/ING(68)21, 1968. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003592.

The purpose of this study consisted not only of providing for a simple calculating method or multi-step cascade, but also of examining some aspects of special importance which arise in optimization calculations of a gaseous diffusion enrichment plant. The results from this study are presented.

0507 FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 7055, 7560, 7770

6979 **(DP-MS—85-134) U_3O_8 powder from uranyl-loaded cation exchange resin.** Mosley, W.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003935.

Large batches of U_3O_8, suitable for powder metallurgy fabrication of Al-U_3O_8 cores for reactor fuel tubes, have been produced by deep-bed calcination of granular uranyl-loaded macroporous sulfonate cation exchange resin at 900 to 950°C in air. Deep-bed calcination is the backup process for the reference process of rotary calcination and sintering. These processes are to be used for recycling uranium, and to produce U_3O_8 in the Fuel Production Facility to be built at the Savannah River Plant. 2 refs., 6 figs.

0508 SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 7774

6980 **(DOE/SR/00952—T12) Reprocessing of nuclear fuel. MODULE 7.** Schneider, A. (Georgia Inst. of Tech., Atlanta (USA)). 20 Apr 1983. Contract AS09-76SR00952. 90p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86003907.

The following aspects of the reprocessing are covered: power reactor fuels; reprocessing schemes; the PUREX process; product conversion; waste management; equipment and facilities; and special reprocessing schemes.

0509 TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 7623

6981 **(BNL-NUREG—36890) Effects of assembly local power distribution on storage rack criticality.** Todosow, M.; Carew, J.F. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 5p. (CONF-851115—12). NTIS, PC A02/MF A01 - GPO. File Number TI85017838.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Fuel storage rack criticality calculations have been performed for a set of 8 x 8 BWR k/sub ∞/-equivalent fuel bundles. The results of these calculations indicate that the storage rack multiplication factor is not determined solely by the k/sub ∞/'s of the individual fuel assemblies, but is also sensitive to the local power, and underlying enrichment, burnable poison, water hole and burnup distributions. Furthermore, in order to insure a true conservative upper bound on the storage rack multiplication factor, reference assemblies with the most centrally peaked power distributions should be selected. 2 refs., 1 fig.

6982 **(DOE/NV/10250—22) Commercial Nuclear Waste Research and Development Program. Quarterly report, July-September 1985.** (Westinghouse Electric Corp., Mercury, NV (USA). Waste Technology Services Div.). Oct 1985. Contract AC08-82NV10250. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86004084.

Nuclear waste handling, packaging, and dry storage testing for the Department of Energy (DOE) Commercial Nuclear Waste Research and Development Program are conducted at the E-MAD (Engine Maintenance, Assembly, and Disassembly) facility in Area 25 of the Nevada Test Site. Brief discussions of E-MAD activities are included in this report. E-MAD costs related to shipping the 17 fuel assemblies located at E-MAD to Idaho, which were contained in April 16, 1985 Fuel Shipment Plan, were revised to show increased dollar costs. The change was due to four-month slip in shipping dates. In accordance with verbal direction from DOE/NV, a schedule is being developed to allow for shipment of the fuel elements during May and June, 1986, and for subsequent closedown

of the E-MAD facility. Closedown activities will be limited to the tasks that can be accomplished within final funding availability. The two archive fuel rods which were removed from fuel assembly B02 prior to the Metal Cask Simulation Test and stored in helium filled containers were reinserted into the fuel assembly and the fuel assembly was returned to lag storage. Four fuel assemblies were removed from welded storage canisters, completing decanisterization of the E-MAD fuel. Post-storage characterization of these fuel assemblies was performed. Integrity monitoring of fuel assemblies in unwelded storage canisters was completed.

6983 **(EPRI-NP—4327) Fuel consolidation demonstration: program overview.** Cope, A.W.; Moscardini, R.L. (Combustion Engineering, Inc., Windsor, CT (USA)). Nov 1985. 31p. Research Reports Center, Box 50490, Palo Alto, Ca 94303. File Number TI86920049.

EPRI, Northeast Utilities, Baltimore Gas and Electric, and Combustion Engineering have begun a program to develop a spent fuel consolidation system licensable by the US Nuclear Regulatory Commission. Fuel consolidation offers a means of substantially increasing the capacity of spent fuel storage pools. This report outlines the work to be performed in the program and briefly describes the consolidation system concept. Equipment design, development, construction, and testing is being performed by Combustion Engineering in Windsor, Connecticut. Northeast Utilities will seek a license for use of the system and storage of consolidated fuel in the Millstone Unit 2 spent fuel storage pool. When licensed, Northeast Utilities will perform a hot demonstration of the integrated system with spent fuel at Millstone.

6984 **Container for radioactive materials.** Fields, S.R. (to Dept. of Energy). US Patent 4,535,250. 13 Aug 1985. Filed date 30 May 1984. vp.

PAT-APPL-615210.

A container for housing a plurality of canister assemblies containing radioactive material and disposed in a longitudinally spaced relation within a carrier to form a payload package concentrically mounted within the container. The payload package includes a spacer for each canister assembly, said spacer comprising a base member longitudinally spacing adjacent canister assemblies from each other and a sleeve surrounding the associated canister assembly for centering the same and conducting heat from the radioactive material in a desired flow path.

6985 **Transporting spent fuel - considerations for safety. From the United States, a review of why the past promotes high standards for the future.** Jefferson, R.M. (Transportation Technology Center, Sandia National Labs., USA). *International Atomic Energy Agency Bulletin;* **27**: No. 1, 5-12(Spr 1985).

Background information that might be useful to a broad range of individuals in developing their own perspectives about the transport of radioactive materials is presented. The safety of transporting spent fuel is addressed from a technical standpoint without the emotional content frequently a part of this argument. Three approaches are adopted. (1) Past history is examined and safety is evaluated on the basis of experience. (2) The subject is approached analytically by combining the various elements of risk involved and assessing them in light of consequences attached to each risk level. (3) Available safety research is reviewed to determine if it might reveal information that would either augment or alter the experience or analysis.

0510 MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 6977, 6996, 7033

6986 **(DOE/EIA—0436(85)) World nuclear fuel cycle requirements 1985.** Moden, R.; O'Brien, B.; Sanders, L.; Steinberg, H. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 5 Dec 1985. 104p. NTIS, PC A06/MF A01 - GPO; GPO Dep. File Number DE86004077.

Projections of uranium requirements (both yellowcake and enrichment services) and spent fuel discharges are presented, corresponding to the nuclear power plant capacity projections presented in "Commercial Nuclear Power 1984: Prospects for the United States and the World" (DOE/EIA-0438(85)) and the "Annual Energy Outlook 1984:" (DOE/EIA-0383(84)). Domestic projections are provided through the year 2020, with foreign projections through 2000. The domestic projections through 1995 are consistent with the integrated energy forecasts in the "Annual Energy Outlook 1984." Projections of capacity beyond 1995 are not part of an integrated energy foreccast; the methodology for their development is explained in "Commercial Nuclear Power 1984." A range of estimates is provided in order to capture the uncertainty inherent in such forward projections. The methodology and assumptions are also stated. A glossary is provided. Two appendixes present additional material. This report is of particular interest to analysts involved in long-term planning for the disposition of radioactive waste generated from the nuclear fuel cycle. 14 figs., 18 tabs.

6987 **(DOE/NBM—5018252) Nuclear fuel authority implementation study (Supplemental task). Final report.** (Stoller (S.M.) Corp., New York (USA)). 15 Mar 1982. Contract W-31-109-ENG-38. 61p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85018252.

A series of different cost data were used in the previously referenced reports with these costs being preliminary in nature and in some cases not precisely defined. In order to be more useful and to more appropriately define other scenario developments as well as to be more easily interpreted by others in the reference fuel cycle, the attached information, calculations and data have been developed. One of the questions on issues related to the fuel cycle back-end operations is the cost recovery and/or financing of/for those several facilities required. The economics of recycle has been reviewed in our previous report, "Nuclear Fuel Authority Implementation Study", November 12, 1981 in which different corporate or pseudo Government organizations were the owners of the back-end facilities. Certain of the assumptions and philosophies are viewed, and data are summarized in the appendices as noted.

0520 WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 6974, 6980, 6980, 6982, 7040, 7041, 7042, 7043, 7044, 7045, 7046, 7047, 7048, 7052, 7053, 7054, 7308, 7462, 7509, 7510, 7513, 7514, 7550, 7605, 7606, 7638, 7787, 7788, 7882, 7884

6988 **(AECL—8851) Waste characterization monitor for low-level radioactive waste management.** Davey, E.C.; Csullog, G.W.; Kupca, S.; Hippola, K.B. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jun 1985. 10p. (CONF-850609—2). Scientific Document Distribution Office, Atomic Energy of Canada Limited, Chalk River, Ontario, Canada. File Number TI86900294.

From 25. annual international conference of the Canadian Nuclear Association and 6. annual conference of the Canadian Nuclear Society; Ottawa, Ontario, Canada (2 Jun 1985).

The exploitation of nuclear processes and technology for the benefit of Canadians results in the routine generation of ~12,000 m^3 of solid low-level radioactive waste annually. To protect the public and the environment, this waste must be isolated for the duration of its potential hazard. In Canada, current planning foresees the development and use of a range of storage and disposal facilities exhibiting differing containment capabilities. To demonstrate adequate isolation safety and to minimize overall costs, the radionuclide content of waste items must be quantified so that the radiological hazards of each waste item can be matched to the isolation capabilities of specific containment facilities. This paper describes a non-invasive, waste characterization monitor that is capable of quantifying the radionuclide content of low-level waste packages to the 9 Bq/g (250 pCi/g) level. The assay technique is based on passive gamma-ray spectroscopy where the concentration of gamma-ray emitting radionuclides in a waste item can be estimated from the analysis of the gamma-ray spectra of the item and calibrated standards. 11 refs., 3 figs., 1 tab.

6980 **(AECL—8853) Waste packages and engineered barriers for the Chalk River Nuclear Laboratories' Disposal Program.** Buckley, L.P. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jul 1985. 28p. (CONF-8506114—3). Scientific Document Distribution Office, Atomic Energy of Canada Limited, Chalk River, Ontario, Canada. File Number TI86900292.

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The Atomic Energy of Canada Limited program aimed at developing a Canadian disposal strategy for low- and intermediate-level radioactive waste is focused on shallow land burial. Open bottom concrete trenches with water-resistant covers will provide the necessary containment for most radionuclides generated from reactor operations. Engineered barriers within these trenches will restrict water movement and curtail radionuclide transport from the waste through the repository to the surrounding biosphere. Experiments are simulating the conditions expected in a shallow land repository. The major results of this study to date include: diffusion coefficients for radionuclides leached from bituminized waste enclosed in water saturated backfill range from 10^{-10} to 10^{-15} m^2/s, two to three orders of magnitude lower than values determined by leaching directly in water; the presence of microbes does not enhance release rates of radionuclides immobilized in bitumen; alterations to groundwater chemistry by leached anions and cations change the radionuclide adsorption in backfill materials; and swelling of waste forms and loss of package integrity is not observed. When wastes which are properly packaged are placed in a repository, the release of radionuclides is diffusion controlled. For a repository located above the water table, where unsaturated groundwater conditions will exist, the waste package should remain stable beyond the period required for the decay of cesium-137 and strontium-90 to innocuous levels. With the combination of engineered barriers and intrusion resistant covers, radionuclides should remain within a shallow land repository. 22 refs., 8 figs., 4 tabs.

6990 **(AERE-G—2960) Solidification of highly active liquid waste. Progress report 1 April 1982 to 31 March 1983.** Morris, J.B. (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Technology Div.). Mar 1985. 149p. NTIS (US Sales Only), PC A07/MF A01. File Number DE86700191.

This document contains the annual progress reports on the following subjects: Joule ceramic melter; microwave vitrification; glass technology; identification, evaluation and review of potential alternative solidification processes; rotary kiln calcination; alternative glass feedstocks; volatile ruthenium trapping by solid adsorbents; irrigated baffle column dust scrubber.

6991 **(AERE-R—11631) Leaks from circular holes in intermediate-level waste canisters.** Rae, J. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Jan 1985. 9p. H.M. Stationery Office, London, price Pound 4.00.

An estimate is made of the rate at which radionuclides will escape through circular holes in a waste canister by diffusing through the internal matrix and surrounding backfill. For a single hole the escaping flux is proportional to its radius rather than its area. The results show that even a canister with appreciable perforations will release only a very small fraction of its contents per year and can still be regarded as a reasonable container.

6992 **(AERE-R—11706) Steady flow in voids and closed cracks in permeable media. 1. Concentric spheres.** Rae, J. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Mar 1985. 12p. H.M. Stationery Office, London, price Pound 4.00.

This paper considers what happens when a steady flow in a permeable medium meets two concentric spheres which have different permeabilities. This can form a first stage model for water flow near an engineered cavity in rock or a concreted waste package placed in filler material as in a nuclear waste repository. Results are obtained in terms of the simplest spherical harmonics, which lets them be used easily. Included are the well-known result that a highly permeable sphere will see only a few times the flux which would occur if it had the permeability of its surroundings, and the less well-known result, though unsurprising, that a spherical region surrounded by a highly permeable shell will see almost no flow, as it will almost all by-pass. A companion paper will include more geometrical effects by replacing the spheres by ellipsoids.

6993 **(BNL—37184) Development of an accelerated leach test(s) for low-level waste forms.** Dougherty, D.R.; Fuhrmann, M.; Colombo, P. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 14p. (CONF-8509121—24). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003632.

From 7. annual DOE LLWMP participants information meeting; Las Vegas, NV, USA (10 Sep 1985).

An accelerated leach test(s) is being developed to predict long-term leaching behavior of low-level radioactive waste (LLW) forms in their disposal environments. As necessary background, a literature survey of reported leaching mechanisms, available mathematical models and factors that affect leaching of LLW forms has been compiled. Mechanisms which have been identified include diffusion, dissolution, ion exchange, corrosion and surface effects. A computerized data base of LLW leaching data and mathematical models is being developed. The data is being used for model evaluation by curve fitting and statistical analysis according to standard procedures of statistical quality control. Long-term leach tests on portland cement, bitumen and vinyl ester-styrene (VES) polymer waste forms are underway which are designed to identify and evaluate factors that accelerate leaching without changing the mechanisms. Initial results on the effect of temperature on leachability indicate that the leach rates of cement and VES waste forms increase with increasing temperature, whereas, the leach rate of bitumen is little affected. 10 refs., 5 figs.

6994 **(BNL-NUREG—28859) Impact of free standing water on interim storage and disposal of radioactive wastes.** Neilson, R.M. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 17p. (CONF-800802—30). NTIS, PC A02/MF A01 - GPO. File Number TI86000104.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

Free standing water (FSW) is water or waste liquids which are not bound by the solidified waste form matrix. As a result, free standing water has the potential for the removal and dispersion of activity. Dependig upon the nature of its chemistry, FSW may also promite waste container corrosion, interact with other waste forms and packages in shallow land burial or degrade the retention capabilities of the disposal geology. The origin of FSW in the following waste forms is discussed: hydraulic cement, urea-formaldehyde, bitumen, and vinyl ester-styrene (thermositting polymers).

6995 **(CONF-8509121—22) Burial trench dynamic compaction demonstration at a humid site.** Spalding, B.P. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003318.

From 7. annual DOE LLWMP participants information meeting; Las Vegas, NV, USA (10 Sep 1985).

This task has the objective of determining the degree of consolidation which can be achieved by dynamic compaction of a closed burial trench within a cohesive soil formation. A seven-year-old burial trench in Solid Waste Storage Area (SWSA) 6 of Oak Ridge National Laboratory (ORNL) was selected for this demonstration. This 251 m^3 trench contained about 80 Ci of mixed radionuclides, mostly ^{90}Sr, in 25 m^3 of waste consisting of contaminated equipment, dry solids, and demolition debris. Prior to compaction, a total trench void space of 79 m^3 was measured by pumping the trench full of water with corrections for seepage. Additional pre-compaction characterization included trench cap bulk density (1.68 kg/L), trench cap permeability (3×10^{-7} m/s), and subsurface waste/backfill hydraulic conductivity (>0.01 m/s). Compaction was achieved by repeatedly dropping a 4-ton steel-reinforced concrete cylinder from heights of 4 to 8 m using the whipline of a 70-ton crane. The average trench ground surface was depressed 0.79 m, with some sections over 2 m, yielding a surveyed volumetric depression which totaled to 64% of the measured trench void space.

Trench cap (0 to 60 cm) bulk density and permeability were not affected by compaction indicating that the consolidation was largely subsurface. Neither surface nor airborne radioactive contamination were observed during repeated monitoring during the demonstration. Dynamic compaction was shown to be an excellent and inexpensive (i.e., about $20/m²) method to collapse trench void space, thereby hastening subsidence and stabilizing the land surface. 15 refs., 10 figs., 3 tabs.

6996 **(DOE/AL/05346—T3) Waste Isolation Pilot Plant Project. Total estimated cost review. Volume I.** (USDOE Albuquerque Operations Office, NM. Waste Isolation Pilot Plant Project Office). May 1979. Contract AC04-78AL05346. 373p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE86003387.

Based on Technical Support Contractor (TSC) preparation and/or comprehensive review of all elements of the WIPP Project Cost Estimate, TSC proposes that $465.4 million be used as the WIPP Total Estimaed Cost (TEC). The basis for this recommendation is described in Section 3.0 of this report. For the direct and indirect cost elements, which includes 52% of the total TEC, it should be noted that the TSC cost review indicates that the Bechtel detailed cost estimate is considered to be reasonable. There are, of course, items in the maze of detail where, in the opinion of TSC estimators, the cost should be different. However, taking the Bechtel cost estimate in total, the TSC recommendation is to use the Bechtel estimate for direct and indirect elements. The relationship of the major cost elements and of the direct and indirect costs are tabulated.

6997 **(DOE/ID/12466—T1) Siting, design and cost of shallow land burial facilities in Northern New England. Volume 2. Appendices A-G.** (Maine Dept. of Environmental Protection, Augusta (USA)). May 1985. Contract FG07-83ID12466. 175p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86003247.

Volume 2 comprises the following Appendices: Existing Environmental Data Base in Maine; Wetland Definition and Classification; Marine Clay; Screening Study; Basal Till Screening Study; Engineering Design Specifications and Costing; New York State Low-Level Radioactive Waste Management; and Maine Yankee's Cost of Low-Level Waste Disposal - 1973-1983.

6998 **(DOE/ID/12466—T2) Siting, design and cost of shallow land burial facilities in northern New England. Volume 1.** (Maine Dept. of Environmental Protection, Augusta (USA)). May 1985. Contract FG07-83ID12466. 144p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86003246.

This study investigated the technical feasibility and cost of shallow land burial (SLB) as one low-level radioactive waste disposal option for Maine and the northern New England states of Maine, New Hampshire, and Vermont. The results are presented in five chapters addressing the licensing process for an SLB facility, the siting process, the engineering design, the cost of disposal, and the cost of transportation. Chapter 2 reviews the Federal and State licensing processes and requirements for development of an SLB facility. Included in this discussion are the stages in the life cycle of SLB facility. Chapter 3 provides site selection criteria for Maine and presents a proposed site selection methodology. The site selection criteria are defined and the reasoning behind their selection is explained. Chapter 4 discusses SLB trench and facility designs and costs. To accommodate different waste volume scenarios, differently sized facilities are discussed, representing Maine going-it-alone and a northern New England compact. Designs and costs of scenarios including nuclear power plant decommissioning wastes are also discussed. Cost estimates of licensing, facility construction, operation, closure, and post closure care are presented for the different waste volume scenarios. Chapter 5 presents estimates of what it would cost LLW generators to dispose of their waste in a Maine-only or a northern New England shallow land burial facility. The reliability of the estimates and their sensitivity to changes in waste volume are also discussed. Chapter 6 examines transportation costs.

6999 **(DOE/LLW—42T-Rev.1) National Low-Level Radioactive Waste Management Program. Use of compensation and incentives in siting Low-Level Radioactive Waste Disposal Facilities. Revision 1.** (EG and G Idaho, Inc., Idaho Falls (USA); American Planning Association, Chicago, IL). Oct 1985. Contract AC07-76ID01570;AC07-83ID12461. 83p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86004109.

This document was prepared to increase understanding of compensation and incentives as they pertain to the siting of Low-Level Radioactive Waste Disposal Facilities. Compensation and incentives are discussed as methods to facilitate siting Low-Level Radioactive Waste Facilities. Compensations may be in the form of grants to enable host communities to evaluate potential impacts of the proposed facility. Compensations may also include reimbursements to the host community for costs incurred during facility construction, operation and closure. These may include required improvements to local roads, new equipment, and payments for revenue losses in local property taxes when disposal sites are removed from the tax base. Incentives provide benefits to the community beyond the costs directly related to the operation of the facility. Greater local control over waste facilities can be a powerful incentive. Local officials may be more willing to accept a facility if they have some control over the operation and monitoring associated with the facility. Failure to secure new disposal sites may cause such problems as illegal dumping which would create public health hazards. Also, lack of disposal capacity may restrict research and medical use of radioactive materials. The use of compensation and incentives may increase acceptance of communities for hosting a low-level waste disposal facility.

7000 **(DOE/RW—0039) Internal Guidelines for interactions with communities and local governments.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Nov 1985. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004091.

These Guidelines provide principles for interactions with local populations. Interaction with communities and local govenments are the responsibility of the Office of Civilian Radioactive Wastes Management program's implementing offices. The Guidelines provide policy direction to these implementing offices, while preserving their ability to tailor local interactions to fit a given situation, taking into account the social and political context and the history of local involvement in the program. Project Offices conduct community and local interactions within overall program resources which must be husbanded prudently. Careful planning by implementing offices should ensure that adequate resources are available to foster effective interactions with local representatives.

7001 **(DP—84-125-2) Waste Management Program. Technical progress report, April-June 1984.** Stevens, W.R. III. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Sep 1985. Contract AC09-76SR00001. 100p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86004081.

This quarterly report provides current information on operations and development programs for the management at SRP and several offsite laboratories of radioactive wastes. The studies on environmental and safety assessments, other support, in-situ storage or disposal, waste form development and characterization, process and equipment development, and the defense waste processing facility are part of the Long-Term Waste Management Technology program. The following studies are reported for the SR Interim Waste Operations Program: tank farm operation, volume reduction of stored waste, inspection program, solid waste operations, waste transfer/tank replacement, and nonradioactive hazardous waste (NRHW).

7002 **(DP—1702) Radionuclide sorption on Savannah River Plant burial ground soil: a summary and interpretation of laboratory data.** Hoeffner, S.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jun 1985. Contract AC09-76SR00001. 58p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86004080.

This report is a summary of radionuclide sorption studies conducted to determine the performance of the low-level waste burial ground at the Savannah River Plant. Distribution coefficients for ^{60}Co, ^{90}Sr, ^{99}Tc, ^{106}Ru, ^{125}Sb, ^{129}I, ^{137}Cs, and /sup 238/239/ Pu are reported. The effects of cations, anions, pH, radionuclide concentration and other variables on radionuclide sorption were evaluated. The pH and radionuclide concentration are the two major factors influencing radionuclide sorption. The pH range observed in the burial ground indicates that a wide range in the amount of radionuclide sorption is to be expected in the burial ground. These laboratory studies are useful for setting upper and lower limits on radionuclide mobility. 30 refs., 15 figs., 16 tabs.

7003 **(DP—1703) Cobalt sorption onto Savannah River Plant soils.** Hoeffner, S.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jun 1985. Contract AC09-76SR00001. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004082.

A laboratory study of cobalt-60 sorption was conducted using Savannah River Plant soil and groundwater from the low-level waste burial ground. Systematic variation of soil and water composition indicates that cobalt sorption is most strongly a function of pH. Over a pH range of 2 to 9, the distribution coefficient ranged from 2 to more than 10,000 mL/g. Changes in clay content and in K^+, Ca^{2+}, or Mg^{2+} concentrations influence cobalt sorption indirectly through the slight pH changes which result. The ions Na^+, Cl^-, and NO_3^- have no effect on cobalt sorption. Ferrous ion, added to groundwater to simulate the condition of water at the bottom of the waste trenches, accounts for part of the decrease in cobalt sorption observed with trench waters. 17 refs., 3 figs., 4 tabs.

7004 **(DP-MS—85-54) Vitrification chemistry and nuclear waste.** Plodinec, M.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 20p. (CONF-850755—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003144.

From Symposium on physics and chemistry of glass and glassmaking; Alfred, NY, USA (30 Jul 1985).

The vitrification of nuclear waste offers unique challenges to the glass technologist. The waste contains 50 or 60 elements, and often varies widely in composition. Most of these elements are seldom encountered in processing commercial glasses. The melter to vitrify the waste must be able to tolerate these variations in composition, while producing a durable glass. This glass must be produced without releasing hazardous radionuclides to the environment during any step of the vitrification process. Construction of a facility to convert the nearly 30 million gallons of high-level nuclear waste at the Savannah River Plant into borosilicate glass began in late 1983. In developing the vitrification process, the Savannah River Laboratory has had to overcome all of these challenges to the glass technologist. Advances in understanding in three areas have been crucial to our success: oxidation-reduction phenomena during glass melting; the reaction between glass and natural wastes; and the causes of foaming during glass melting.

7005 **(DP-MS—85-56) Analytical methods and laboratory facility for the Defense Waste Processing Facility.** Coleman, C.J.; Dewberry, R.A.; Lethco, A.J.; Denard, C.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1985. Contract AC09-76SR00001. 7p. (CONF-850937—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003143.

From 28. conference on analytical chemistry; Knoxville, TN, USA (30 Sep 1985).

This paper describes the analytical methods, instruments, and laboratory that will support vitrification of defense waste. The Defense Waste Processing Facility (DWPF) is now being constructed at Savannah River Plant (SRP). Beginning in 1989, SRP high-level defense waste will be immobilized in borosilicate glass for disposal in a federal repository. The DWPF will contain an analytical laboratory for performing process control analyses. Additional analyses will be performed for process history and process diagnostics. The DWPF analytical facility will consist of a large shielded sampling cell, three shielded analytical cells, a laboratory for instrumental analysis and chemical separations, and a counting room. Special instrumentation is being designed for use in the analytical cells, including microwave drying/dissolution apparatus, and remote pipetting devices. The instrumentation laboratory will contain inductively coupled plasma, atomic absorption, Moessbauer spectrometers, a carbon analyzer, and ion chromatography equipment. Counting equipment will include intrinsic germanium detectors, scintillation counters, Phoswich alpha, beta, gamma detectors, and a low-energy photon detector.

7006 **(DPST—85-731) Non-radioactive stand-in for radioactive contamination. I. Non-radioactive tests.** Rohe, M.J.; Rankin, W.N.; Postles, R.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 8 Oct 1985. Contract AC09-76SR00001. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003951.

Candidate non-radioactive materials for use as a stand-in for radioactive contamination during application of a high-pressure, hot water decontamination were identified and evaluated. A stand-in for radioactive contamination is needed to evaluate the decontaminability of replacement canyon cranes at the manufacturers location where actual radioactive contamination cannot be used. This evaluation was conducted using high-pressure, hot-water at 420 psi, 190°F, and 20 gal/min through a 1/8-in.-diam nozzle, the decontamination technique preferred by SRP Separations Department for this application. A non-radioactive stand-in for radioactive contamination was desired that would be removed by direct blast stream contact but would remain intact on surfaces where direct contact does not occur. This memorandum describes identification of candidate non-radioactive stand-in materials and evaluation of these materials in screening tests and tests with high-pressure, hot-water blasting. The following non-radioactive materials were tested: carpenter's line chalk; typing correction fluid; dye penetrant developer; latex paint with attapulyite added; unaltered latex paint; gold enamel; layout fluid; and black enamel. Results show that blue layout fluid and gold enamel have similar adherence that is within the range expected for actual radioactive contamination. White latex paint has less adherence than expected for actual radioactive contamination. The film was removed at a rate of <1 sec/in.^{2}. Black enamel has more adherence than expected from actual radioactive contamination. In these tests ASTM No. 2B surfaces were harder to clean than either ASTM No. 1 or electropolished surfaces which had similar cleaning properties. A 90° blast angle was more effective than a 45° blast angle. In these tests there was no discernible effect of blast distance between 1 and 3 ft.

7007 **(IOS-Rep—204) Status report on research at the Institute of Oceanographic Sciences related to the possible disposal of radioactive waste on or beneath the seafloor April 1979-March 1984.** Booty, B. (ed.). (Institute of Oceanographic Sciences, Godalming (UK)). 1985. 333p. NTIS (US Sales Only), PC A15/MF A01. File Number DE86700210.

This report summarises all of the research carried out by the Institute of Oceanographic Sciences in connection with the possible disposal of radioactive waste at sea. It covers the period April 1, 1979 to March 31, 1984. All the work mentioned here is reported upon, usually in much greater detail, in a series of individual reports.

7008 **(LA—10479-MS) TRU waste-sampling program.** Warren, J.L.; Zerwekh, A. (Los Alamos National Lab., NM (USA)). Aug 1985. Contract W-7405-ENG-36. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86003281.

As part of a TRU waste-sampling program, Los Alamos National Laboratory retrieved and examined 44 drums of ^{238}Pu- and ^{239}Pu-contaminated waste. The drums ranged in age from 8 months to 9 years. The majority of drums were tested for pressure, and gas samples withdrawn from the drums were analyzed by a mass spectrometer. Real-time radiography and visual examination were used to determine both void volumes and waste content. Drum walls were measured for deterioration, and selected drum contents were reassayed for comparison with original assays and WIPP criteria. Each drum tested at atmospheric pressure. Mass spectrometry revealed no problem with ^{239}Pu-contaminated waste, but three 8-month-old drums of ^{238}Pu-contaminated waste contained a potentially hazardous gas mixture. Void volumes fell within the 81 to 97% range. Measurements of drum walls showed no significant cor-

rosion or deterioration. All reassayed contents were within WIPP waste acceptance criteria. Five of the drums opened and examined (15%) could not be certified as packaged. Three contained free liquids, one had corrosive materials, and one had too much unstabilized particulate. Eleven drums had the wrong (or not the most appropriate) waste code. In many cases, disposal volumes had been inefficiently used. 2 refs., 23 figs., 7 tabs.

7009 **(NUREG/CR—0986) Impact of decontamination of LWR radioactive waste treatment systems.** Perrigo, L.D.; Divine, J.R.; Hoenes, G.R.; Faust, L.G. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1979. Contract AC06-76RL01830. 135p. (PNL—3297). NTIS, PC A07/MF A01 - GPO. File Number TI86000099.

N-Reactor is the only operating power reactor in the US that is currently ready for a full system decontamination. Only at N-Reactor is there a means to accommodate radwaste produced during decontamination. Solidification of the processed decontamination waste may be a significant problem. Disposal of the large amounts of concentrated wastes resulting from the operation of the radwaste treatment system may be a problem because of its high radioactivity. Based on discussions with utilities; there is doubt that construction materials in current radwaste treatment systems are capable of handling the chemicals from a concentrated process. The total storage volume for concentrated decontamination is not sufficient in existing radwaste treatment systems. Greater attention should be placed on designing reactors and radwaste treatment systems for decontamination; occupational exposure and the ALARA philosophy should be considered. As long as concentrated decontamination procedures are considered to be viable alternatives for reducing radiation levels around reactor primary systems, fuel decontamination procedures should also be considered and developed. If dilute solution decontamination is to be considered as a means for reducing radiation levels and exposure around reactor primary systems, a demonstration of such a process is needed on both BWR and PWR systems. A detailed means of handling waste material resulting from leaks in the primary system during the decontamination must be available. On-site storage of solidified decontamination wastes may be a viable option, but license amendments may be necessary. To determine the cost incentives for decontamination, long-term benefits associated with reduced occupational exposure and increased operating efficiency should be balanced against the immediate costs for the decontamination including building modification, reactor downtime and personnel exposure. Decontamination safety must be addressed.

7010 **(NUREG/CR—2343) Risk methodology for geologic disposal of radioactive waste: the DNET Computer Code User's Manual.** Cranwell, R.M.; Campbell, J.E.; Stuckwisch, S.E. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1982. Contract AC04-76DP00789. 159p. (SAND—81-1663). NTIS, PC A08/MF A01 - GPO. File Number TI86004154.

This report describes a network flow model (DNET) for use in simulating the process of salt dissolution in bedded salt formations. Included in the model are the capabilities for simulating processes such as salt creep, subsidence, and thermomechanical effects, all of which can affect the salt dissolution process. The model was developed for use by the Nuclear Regulatory Commission in the analysis of nuclear waste facilities in deep bedded salt formations. This document is a user's manual and is intended to facilitate the use of the DNET simulator. Mathematical equations, submodels and a description of the flow network are given. A complete input data guide is included as well as four sample problems with input deck descriptions and associated output.

7011 **(NUREG/CR—4110) Repository site data report for unsaturated tuff, Yucca Mountain, Nevada.** Tien, P.L.; Updegraff, C.D.; Siegel, M.D.; Wahi, K.K.; Guzowski, R.V. (Sandia National Labs., Albuquerque, NM (USA); Science Applications International Corp., Albuquerque, NM (USA); Remote Sensing System, Inc., Albuquerque, NM (USA)). Nov 1985. Contract AC04-76DP00789. 400p. (SAND—84-2668). NTIS, PC A17/MF A01 - GPO. File Number TI86003566.

The US Department of Energy is currently considering the thick sequences of unsaturated, fractured tuff at Yucca Mountain, on the southwestern boundary of the Nevada Test Site, as a possible candidate host rock for a nuclear-waste repository. Yucca Mountain is in one of the most arid areas in the United States. The site is within the south-central part of the Great Basin section of the Basin and Range physiographic province and is located near a number of silicic calderas of Tertiary age. Although localized zones of seismic activity are common throughout the province, and faults are present at Yucca Mountain, the site itself is basically aseismic. No data are available on the composition of ground water in the unsaturated zone at Yucca Mountain. It has been suggested that the composition is bounded by the compositions of water from wells USW-H3, UE25p-1, J-13, and snow or rain. There are relatively few data available from Yucca Mountain on the moisture content and saturation, hydraulic conductivity, and characteristic curves of the unsaturated zone. The available literature on thermomechanical properties of tuff does not always distinguish between data from the saturated zone and data from the unsaturated zone. Geochemical, hydrologic, and thermomechanical data available on the unsaturated tuffs of Yucca Mountain are tabulated in this report. Where the data are very sparse, they have been supplemented by data from the saturated zone or from areas other than Yucca Mountain. 316 refs., 58 figs., 37 tabs.

7012 **(ORNL/TM—9771) Automated procedure for calculating time-dependent sensitivities in ORIGEN2.** Worley, B.A.; Wright, R.Q. (Oak Ridge National Lab., TN (USA)). Oct 1985. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002554.

ORIGEN2 is a widely used point-depletion and radioactive-decay computer code for use in simulating nuclear fuel cycles and/or spent fuel characteristics. This paper presents the application of the GRESS procedure to the ORIGEN2 code for performing a sensitivity analysis of a high-level waste disposal problem. The GRESS procedure uses computer calculus and the GRESS precompiler to automate the generation and calculation of gradients in a computer code. The GRESS version of ORIGEN2 is used to calculate the nuclide-dependent sensitivities of the decay heat and radioactivity of 1008 nuclides comprising reprocessed high-level waste to changes in data and input parameters. The sensitivities are calculated in a single execution of the revised code as compared to the conventional method of rerunning the code numerous times. The availability of sensitivity data as an option in ORIGEN2 reveals relationships not easily recognized even with reruns.

7013 **(PNL—5491) Physical and numerical modeling of Joule-heated melters.** Eyler, L.L.; Skarda, R.J.; Crowder, R.S. III; Trent, D.S.; Reid, C.R.; Lessor, D.L. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 175p. NTIS, PC A08/MF A01; GPO Dep. File Number DE86003793.

The Joule-heated ceramic-lined melter is an integral part of the high level waste immobilization process under development by the US Department of Energy. Scaleup and design of this waste glass melting furnace requires an understanding of the relationships between melting cavity design parameters and the furnace performance characteristics such as mixing, heat transfer, and electrical requirements. Developing empirical models of these relationships through actual melter testing with numerous designs would be a very costly and time consuming task. Additionally, the Pacific Northwest Laboratory (PNL) has been developing numerical models that simulate a Joule-heated melter for analyzing melter performance. This report documents the method used and results of this modeling effort. Numerical modeling results are compared with the more conventional, physical modeling results to validate the approach. Also included are the results of numerically simulating an operating research melter at PNL. Physical Joule-heated melters modeling results used for qualiying the simulation capabilities of the melter code included: (1) a melter with a single pair of electrodes and (2) a melter with a dual pair (two pairs) of electrodes. The physical model of the melter having two electrode pairs utilized a configuration with primary and secondary electrodes. The principal melter parameters (the ratio of power applied to each electrode pair, modeling fluid depth, electrode spacing) were varied in nine tests of the physical model during FY85. Code predictions were made for five of these tests. Voltage drops, temperature field data, and electric field data varied in their agreement with the physical

modeling results, but in general were judged acceptable. 14 refs., 79 figs., 17 tabs.

7014 **(PNL—5577-8) Fabrication and characterization of MCC approved testing material - ATM-8 glass.** Wald, J.W. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003801.

The Materials Characterization Center (MCC) Approved Testing Material ATM-8 is a borosilicate glass that incorporates elements typical of high-level waste (HLW) resulting from the reprocessing of commercial nuclear reactor fuel. Its composition is based upon the simulated HLW glass type 76-68 (Mendel, J.E. et al., 1977, Annual Report of the Characteristics of High-Level Waste Glasses, BNWL-2252, Pacific Northwest Laboratory, Richland, Washington), to which depleted uranium, technetium-99, neptunium-237 and plutonium-239 have been added at moderate to low levels. The glass was requested by the Nevada Nuclear Waste Storage Investigations (NNWSI) Project. It was produced by the MCC at the Pacific Northwest Laboratory (PNL) operated for the Department of Energy (DOE) by Battelle Memorial Institute. ATM-8 glass was produced in April of 1984, and is the second in a series of testing materials for NNWSI. This report discusses its fabrication (starting materials, batch and glass preparation, measurement and testing equipment, other equipment, procedures, identification system and materials availability and storage, and characterization (bulk density) measurements, chemical analysis, microscopic examination, and x-ray diffraction analysis. 4 refs., 2 figs., 10 tabs.

7015 **(PNL—5581) Investigation of potential analytical methods for redox control of the vitrification process.** Goldman, D.S. (Pacific Northwest Labs., Richland, WA (USA)). Nov 1985. Contract AC06-76RL01830. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003838.

An investigation was conducted to evaluate several analytical techniques to measure ferrous/ferric ratios in simulated and radioactive nuclear waste glasses for eventual redox control of the vitrification process. Redox control will minimize the melt foaming that occurs under highly oxidizing conditions and the metal precipitation that occurs under highly reducing conditions. The analytical method selected must have a rapid response for production problems with minimal complexity and analyst involvement. The wet-chemistry, Moessbauer spectroscopy, glass color analysis, and ion chromatography techniques were explored, with particular emphasis being placed on the Moessbauer technique. In general, all of these methods can be used for nonradioactive samples. The Moessbauer method can readily analyze glasses containing uranium and thorium. A shielded container was designed and built to analyze fully radioactive glasses with the Moessbauer spectrometer in a hot cell environment. However, analyses conducted with radioactive waste glasses containing ^{90}Sr and ^{137}Cs were unsuccessful, presumably due to background radiation problems caused by the samples. The color of glass powder can be used to analyze the ferrous/ferric ratio for low chromium glasses, but this method may not be as precise as the others. Ion chromatography was only tested on nonradioactive glasses, but this technique appears to have the required precision due to its analysis of both Fe^{+2} and Fe^{+3} and its anticipated adaptability for radioactivity samples. This development would be similar to procedures already in use for shielded inductively coupled plasma emission (ICP) spectrometry. Development of the ion chromatography method is therefore recommended; conventional wet-chemistry is recommended as a backup procedure.

7016 **(PNL—5604) Model assessment of protective barrier designs.** Fayer, M.J.; Conbere, W.; Heller, P.R.; Gee, G.W. (Pacific Northwest Labs., Richland, WA (USA)). Nov 1985. Contract AC06-76RL01830. 59p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86003545.

A protective barrier is being considered for use at the Hanford site to enhance the isolation of previously disposed radioactive wastes from infiltrating water, and plant and animal intrusion. This study is part of a research and development effort to design barriers and evaluate their performance in preventing drainage. A fine-textured soil (the Composite) was located on the Hanford site in sufficient quantity for use as the top layer of the protective barrier. A number of simulations were performed by Pacific Northwest Laboratory to analyze different designs of the barrier using the Composite soil as well as the finer-textured Ritzville silt loam and a slightly coarser soil (Coarse). Design variations included two rainfall rates (16.0 and 30.1 cm/y), the presence of plants, gravel mixed into the surface of the topsoil, an impermeable boundary under the topsoil, and moving the waste form from 10 to 20 m from the barrier edge. The final decision to use barriers for enhanced isolation of previously disposed wastes will be subject to decisions resulting from the completion of the Hanford Defense Waste Environmental Impact Statement, which addresses disposal of Hanford defense high-level and transuranic wastes. The one-dimensional simulation results indicate that each of the three soils, when used as the top layer of the protective barrier, can prevent drainage provided plants are present. Gravel amendments to the upper 30 cm of soil (without plants) reduced evaporation and allowed more water to drain.

7017 **(PNL—5632) Shredder and incinerator technology for treatment of commercial transuranic wastes.** Oma, K.H.; Westsik, J.H. Jr.; Ross, W.A. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 103p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86003959.

This report describes the selection and evaluation of process equipment to accomplish the shredding and incineration of commercial TRU wastes. The primary conclusions derived from this study are: Shredding and incineration technology appears effective for converting simulated commercial TRU wastes to a noncombustible form. The gas-heated controlled-air incinerator received the highest technical ranking. On a scale of 1 to 10, the incinerator had a Figure-of-Merit (FOM) number of 7.0. This compares to an FOM of 6.1 for the electrically heated controlled-air incinerator and an FOM of 5.8 for the rotary kiln incienrator. The present worth costs of the incineration processes for a postulated commercial reprocessing plant were lowest for the electrically heated and gas-heated controlled-air incinerators with costs of $16.3 M and $16.9 M, respectively (1985 dollars). Due to higher capital and operating costs, the rotary kiln process had a present worth cost of $20.8 M. The recommended process from the three evaluated for the commercial TRU waste application is the gas-heated controlled-air incinerator with a single stage of shredding for feed pretreatment. This process had the best cost-effectiveness ratio of 1.0 (normalized). The electrically heated controller-air incinerator had a rating of 1.2 and the rotary kiln rated a 1.5. Most of the simulated wastes were easily processed by the low-speed shredders evaluated. The HEPA filters proved difficult to process, however. Wood-framed HEPA filters tended to ride on the cutter wheels and spacers without being gripped and shredded. The metal-framed HEPA filters and other difficult to shred items caused the shredders to periodically reach the torque limit and go into an automatic reversal cycle; however, the filters were eventually processed by the units. All three incinerators were ineffective for oxidizing the aluminum metal used as spacers in HEPA filters.

7018 **(PNL—5657) Development of the CEPOD process for dissolving plutonium oxide and leaching plutonium from scrap or wastes.** Bray, L.A.; Ryan, J.L.; Wheelwright, E.J. (Pacific Northwest Labs., Richland, WA (USA)). Nov 1985. Contract AC06-76RL01830. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003542.

Laboratory-scale dissolving tests have demonstrated that PuO_2, fired at temperatures between 950 and 1700°C, can be dissolved at 25 to 35°C to concentrations exceeding 100 g Pu/L in an electrochemical dissolver using silver ion as a redox catalyst. The dissolution rates are 2 to 5 times faster than the rates obtained using the current process (12 M HNO_3-0.18 M HF at 90°C) and the corrosive fluoride ion is avoided. 4 refs., 5 figs., 1 tab.

7019 **(PNL-SA—13475) Link between laboratory/field observations and models.** Cole, C.R.; Foley, M.G. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 15p. (CONF-8510131—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86004029.

From Workshop on systems performance assessments for the safety of radioactive waste disposal; Paris, France (22 Oct 1985).

The various linkages in system performance assessments that integrate disposal program elements must be understood. The link-

age between model development and field/laboratory observations is described as the iterative program of site and system characterization for development of an observational-confirmatory data base to develop, improve, and support conceptual models for site and system behavior. The program consists of data gathering and experiments to demonstrate understanding at various spatial and time scales and degrees of complexity. Understanding and accounting for the decreasing characterization certainty that arises with increasing space and time scales is an important aspect of the link between models and observations. The performance allocation process for setting performance goals and confidence levels coupled with a performance assessment approach that provides these performance and confidence estimates will resolve when sufficient characterization has been achieved. At each iteration performance allocation goals are reviewed and revised as necessary. The updated data base and appropriate performance assessment tools and approaches are utilized to identify and design additional tests and data needs necessary to meet current performance allocation goals. 9 refs.

7020 **(RFP—2016) Fluid bed incineration.** Ziegler, D.L.; Johnson, A.J.; Meile, L.J. (Dow Chemical Co., Golden, CO (USA). Rocky Flats Div.). 8 Jun 1973. Contract AC04-76AL01106. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004075.

A fluid bed incineration was tested on a laboratory scale for combustion of typical, plant-waste material. Sodium carbonate bed material is used for the in situ neutralization of the hydrogen chloride generated by the large amounts of polyvinyl chloride burned. Waste preparation and an evaluation of catalytic after-burning of reactor off-gases is included. 2 refs., 3 figs., 15 tabs.

7021 **(RHO-RE-EV—78-L) Waste Receiving and Processing (WRAP) facility engineering study.** Christie, M.A.; Cammann, J.W.; McBeath, R.S.; Rode, H.H. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 30 Sep 1985. Contract AC06-77RL01030. 139p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86004019.

A new Hanford waste management facility, the Waste Receiving and Processing (WRAP) facility (planned to be operational by FY 1994) will receive, inspect, process, and repackage contact-handled transuranic (CH-TRU) contaminated solid wastes. The wastes will be certified according to the waste acceptance criteria for disposal at the Waste Isolation Pilot Plant (WIPP) geologic repository in southeast New Mexico. Three alternatives which could cost effectively be applied to certify Hanford CH-TRU waste to the WIPP Waste Acceptance Criteria (WIPP-WAC) have been examined in this updated engineering study. The alternatives differed primarily in the reference processing systems used to transform nonconforming waste into an acceptable, certified waste form. It is recommended to include the alternative of shredding and immobilizing nonconforming wastes in cement (shred/grout processing) in the WRAP facility. Preliminary capital costs for WRAP in mid-point-of-construction (FY 1991) dollars were estimated at $45 million for new construction and $37 million for modification and installation in an existing Hanford surplus facility (231-Z Building). Operating, shipping, and decommissioning costs in FY 1986 dollars were estimated at $126 million, based on a 23-y WRAP life cycle (1994 to 2017). During this period, the WRAP facility will receive an estimated 38,000 m^3 (1.3 million ft^3) of solid CH-TRU waste. The study recommends pilot-scale testing and evaluation of the processing systems planned for WRAP and advises further investigation of the 231-Z Building as an alternative to new facility construction.

7022 **(SAND—83-7011) Three-well technique for determining formation anisotropy at the Waste Isolation Pilot Plant (WIPP), southeast New Mexico.** Walter, G.R. (Hydro Geo Chem., Inc., Tucson, AZ (USA)). May 1983. Contract AC04-76DP00789. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004172.

The traditional methods used by hydrologists for determining the principal components of transmissivity in anisotropic aquifers are based on techniques developed by Papadopulos (1965) and Hantush (1966). Their procedures are based on the assumption that an aquifer test well be performed with one pumped well and require a minimum of three observation wells to completely define the direction and magnitudes of the principal components of transmissivity. The theory and techniques described in this report represent an extension of the techniques presented by Papadopulos and Hantush in support of the theory that more than one well in a well array can be pumped. In this case, the transmissivity tensor can be completely defined using a three-well array, if two aquifer tests are performed by sequentially pumping two of the wells. 9 refs.

7023 **(SAND—84-1451) Ninth international NEA/Seabed Working Group meeting, Berlin, FRG, March 27-29, 1984.** Anderson, D.R. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Aug 1985. Contract AC04-76DP00789. 162p. (CONF-8403207—). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85017595.

From 9. international NEA/Seabed Working Group meeting; Berlin, F.R. Germany (27 Mar 1984).

This report is an account of work sponsored by the Governments of Canada, France, the Federal Republic of Germany, Japan, the Netherlands, Switzerland, United Kingdom, and the United States, and by the Commission of the European Communities, in the framework of the OECD/NEA Coordinated Programme on Seabed Disposal of Radioactive Waste. The objective of the NEA Coordinated Programme is to provide an international assessment of the technical feasibility and long-term safety of seabed disposal of high-level radioactive waste as a multi-media concept with marine sediments as the primary isolation barrier.

7024 **(SAND—84-7207) Nevada Nuclear Waste Storage Investigations Project: thermal analysis of spent fuel disposal in vertical emplacement boreholes in a welded tuff repository.** St. John, C.M. (Agbabian Associates, El Segundo, CA (USA)). Nov 1985. Contract AC04-76DP00789. 60p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86003445.

Two- and three-dimensional heat transfer analyses were conducted to determine temperatures in the vicinity of a waste canister and an emplacement drift. The effect of emplacement of canisters containing spent fuel in vertical boreholes was simulated for the cases of an emplacement drift either fully ventilated or sealed immediately after canister emplacement. PORFLOW and THERM3D respectively solve the two- and three-dimensional forms of the diffusion equation. In the unventilated case, the effect of radiation was approximated by defining an equivalent radiation thermal conductivity. A simple code, TEMP3D, based on the closed form solutions for constant and decaying heat sources, was also used. Calculations indicate that the temperature at the canister borehole wall will peak at about 215°C if the drift is ventilated and about 240°C if it is unventilated. The peak temperature occurs sooner in the ventilated case; after 3 to 4 yr versus 9 yr. For a point 1 m from the wall of the emplacement borehole, the corresponding peak temperatures are 150°C for the ventilated case and 185°C for the unventilated case and occur at about 5 and 17 yr. We assumed that the effect of drift ventilation would be to maintain a uniform temperature of 30°C at the drift perimeter. If the drift is unventilated the wall rock temperature peaks some 75 to 100 yr after waste emplacement; reaching about 125°C at the mid-height of the drift wall. Comparisons between the results of the three-dimensional analyses performed using TEMP3D and THERM3D indicated that the simpler modeling technique provided a good estimate of temperatures in the immediate vicinity of the canister for both the ventilated and unventilated cases. Comparisons of the results of two- and three-dimensional analyses performed using the PORFLOW and THERM3D codes indicated that the two-dimensional approximation is excellent, except in the immediate vicinity of the canister.

7025 **(SAND—85-0559C) WIPP waste package performance testing on simulated DHLW: early data.** Molecke, M.A. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 11p. (CONF-850918—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003242.

From International topical meeting on high level nuclear waste disposal - technology and engineering; Pasco, WA, USA (24 Sep 1985).

Several waste package performance experiments are currently being conducted at the Waste Isolation Pilot Plant (WIPP) facility. These experiments involve 18 full-size, simulated (nonradioactive) defense high-level waste (DHLW) containers of several waste package designs. These DHLW packages are emplaced in vertical boreholes in bedded rock salt, under both (thermal) near-reference and accelerated-aging repository conditions. A major purpose of these experiments is to evaluate the in situ materials performance (i.e., degradation and alteration) of the various waste package barriers: metallic waste canisters and overpacks, backfill materials, and high-level glass waste form (nonradioactive). The waste package test emplacements are heavily instrumented, providing remote readouts of in situ temperatures, pressures, moisture inflow, and container tilt. No materials samples have been removed for laboratory analyses to date, but about five months of instrumentation data have been acquired. This paper describes the current technical status of these WIPP tests and discusses the available, early results. 14 refs., 3 figs.

7026 **(SAND—85-1445) Thermal Response Studies. 1983 Subseabed Disposal Project annual report, October 1982-September 1983.** Percival, C.M. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1985. Contract AC04-76DP00789. 160p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86003839.

This report covers the FY83 Thermal Response Studies conducted by the Subseabed Disposal Project. A summary of the work is given which includes an introduction and general descriptions of the year's activities. Detailed discussions are included as appendices. The major accomplishments during FY83 include: analysis and the explanation of the thermal data from the In Situ Heat Transfer Experiment (ISHTE) Simulation; continued laboratory experiments to verify the MARIAH heat transfer, fluid flow numerical code; design and fabrication of major components and experiments from ISHTE; and preparation for the ISHTE Component Test Cruise scheduled for September 1984.

7027 **(SKB-KBS-TR—84-09) Comparative study of geological, hydrological, and geophysical borehole investigations.** Magnusson, K.A.; Duran, O. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Sep 1984. 147p. NTIS (US Sales Only), PC A07/MF A01. File Number DE86700214.

Understanding the permeability of the bedrock can be improved by supplementing the results of water injection tests with information from core mapping, TB-inspection and borehole geophysics. The comparison between different borehole investigations encompasses core mapping, TV-inspection and various geophysical borehole measurements. The study includes data from two different study areas, Kraakemaala and Finnsjoen, in which extensive geological, hydrological and geophysical investigations have been carried out. The fractures and microfractures in crystalline rock constitute the main transport paths for both ground water and electric currents. They will therefore govern both the permeability and the resistivity of the rock. In order to get a better understanding of the influence of fractures on permeability and resistivity, a detailed comparison has been made between the hydraulic conductivity, respectively, and the character of fractures in the core and the borehole wall. The fractures show very large variations in hydraulic conductivity. Microfractures and most of the thin fractures have no measurable hydraulic conductivity (in this case $< 2 \times 10^{-9}$ m s^{-1}), while test sections which contain a single isolated fracture can have no measurable to rather high hydraulic conductivities ($> 10^{-7}$ m s^{-1}). Wide fracture zones often have hydraulic conductivities which vary from very low (less than 2×10^{-9} m s^{-1}) to high values (10^{-5} m s^{-1}), indicating that the hydraulic conductivity is governed by a few discrete fractures. The resistivity shows a continous variation in the range 1,000- 100,000 ohm-m and a relatively poor correlation with hydraulic conductivities. The observed difference is considered to the effect of restriction of water flow on a few channels, while electric surface condition, i.e. current transport through thin water films, makes current transport possible through fractures with very small aperatures.

7028 **(SKB-KBS-TR—84-10) Geochemical simulation of the evolution of granitic rocks and clay minerals submitted to a temperature increase in the vicinity of a repository for spent nuclear fuel.** Fritz, B.; Kam, M.; Tardy, Y. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Jul 1984. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86700215.

The alteration of a granitic rock around a repository for spent nuclear fuel has been simulated considering the effect of an increase of temperature due to this kind of induced geothermal system. The results of the simulation have been interpreted in terms of mass transfer and volumic consequences. The alteration proceeds by dissolution of minerals (with an increase of the volumes of fissures and cracks) and precipitation of secondary minerals as calcite and clay minerals particularly (with a decrease of the porosity). The increase of the temperature from 10 degrees C to about 100 degrees C will favour the alteration of the granitic rock around the repository by the solution filling the porosity. The rock is characterized by a very low fissure porosity and a consequent very low water velocity. This too, favours intense water rock interactions and production of secondary clays and the total possible mass transfer will decrease the porosity. A combination of these thermodynamic mass balance calculations with a kinetic approach of mineral dissolutions gives a first attempt to calibrate the modelling in the time scale: the decrease of porosity can be roughly estimated between 2 and 20% for 100,000 years. The particular problem of Na-bentonites behaviour in the proximate vicinity of the repository has been studied too. One must distinguish between two types of clay-water interactions: -within the rock around the repository, Na-bentonites should evolute with illitization in slighltly open system with low clay/water ratios, -within the repository itself, the clay reacts in a closed system for a long time with high clay/water ratios and a self-buffering effect should maintain the bentonite type. This chemical buffering effect is a positive point for the use of this clay as chemical barrier.

7029 **(SKB-KBS-TR—84-11) Smectite alteration.** Anderson, D.M. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Nov 1984. 215p. (CONF-8312124—Summs.). NTIS (US Sales Only), PC A10/MF A01. File Number DE86700216.

From Workshop on smectite alteration; Washington, DC, USA (8 Dec 1983).

This report contains the proceedings of a second workshop in Washington DC December 8-9, 1983 on the alteration of smectites intended for use as buffer materials in the long-term containment of nuclear wastes. It includes extended summaries of all presentations and a transcript of the detailed scientific discussion. The discussions centered on three main questions: What is the prerequisite for and what is the precise mechanism by which smectite clays may be altered to illite. What are likely sources of potassium with respect to the KBS project. Is it likely that the conversion of smectite to illite will be of importance in the 10^5 to the 10^6 year time frame. The workshop was convened to review considerations and conclusions in connection to these questions and also to broaden the discussion to consider the use of smectite clays as buffer materials for similar applications in different geographical and geological settings. SKBF/KBS technical report 83-03 contains the proceedings from the first workshop on these matters that was held at the State University of New York, Buffalo May 26-27, 1982.

7030 **(SKB-KBS-TR—84-14) Treatment of zircaloy cladding hulls by isostatic pressing.** Tegman, R.; Burstroem, M. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Dec 1984. 42p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86700218.

A method for the treatment of Zircaloy fuel hulls is proposed. It involves hot isostatic pressing (HIP) for making large, completely densified metallic bodies of the waste. The hulls are packed into a bellows-shaped container of steel. On packing the fuel hulls give a filling factor of only 14%, which is too low for non-deformable compaction in a normal container, but by using a bellowed container, a non-deformable compaction can be obtained without any pretreatment of the hulls. Fully dense and mechanically strong blocks of Zircaloy can be fabricated by holding them at temperatures of around 1000 degrees C for three hours. It is also

feasible to incorporate the other metallic parts of the fuel bundle, such as top and bottom tie plates and spacers, in the pressing. The HIP-densified hulls provide an effective means of self-containment of radioactive waste due to the excellent corrosion resistance of Zircaloy. A waste loading factor of close to 100% can be realized. Futher, a volume reduction factor of 7 and a surface reduction factor of about 250 for a 1-ton canister can be achieved. Equilibrium calculations have shown that tritium present in the hulls can quantitatively be contained in the HIPed block. A study has been made of a possible process for industrial scale use.

7031 **(UCRL—92891) LWR spent fuel characteristics relevant to performance as a wasteform in a potential tuff repository.** Wilson, C.N.; Einziger, R.E.; Woodley, R.E.; Oversby, V.M. (Westinghouse Hanford Co., Richland, WA (USA); Lawrence Livermore National Lab., CA (USA)). Jun 1985. Contract W-7405-ENG-48. 5p. (CONF-851115—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE85016285.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

A testing program has been initiated to determine the probable condition of spent fuel during the post-containment period under NNWSI site specific conditions, and to determine relevant radionuclide release rates for spent fuel. The current testing program is focused on three subject areas: (1) spent fuel leaching/dissolution behavior, (2) spent fuel oxidation, and (3) cladding corrosion. Results are presented. 3 refs.

7032 **(USGS-OFR—84-661) Data report for the 1983 seismic-refraction experiment at Yucca Mountain, Beatty and vicinity, southwestern Nevada.** Sutton, V.D. (Geological Survey, Menlo Park, CA (USA)). 1984. Contract AI08-78ET44802. 196p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86002909.

In June 1983, the US Geological Survey (USGS) conducted a seismic-refraction survey in the vicinity of Yucca Mountain and Beatty, Nevada to better define the P(compressional)-wave velocity structure of the upper crust in this area. This experiment is part of continuing seismic investigations in the region of the Nevada Test Site (NTS) by the USGS on behalf of the Nevada Nuclear Waste Storage Investigation Project (NNWSI) to aid in determining the feasibility of the proposed nuclear waste disposal site at Yucca Mountin. The 1983 seismic-refraction survey consisted of ten individual explosions at nine shotpoints, recorded by two deployments of 120 portable seismographs constituting North-South and East-West profiles (Plate 1). The North-South profile extended 45 kilometers along the western flank of Yucca Mountain. Recorder station spacing averaged 0.40 km, and seven shots spaced 8 km apart were fired. The East-West profile extended 60 km from Yucca Mountain west through Fluorspar Canyon and Titus Canyon to the floor of Death Valley, California. Recorder station spacing averaged 0.40 km to 0.60 km and three shots were fired at Yucca Mountain, near Beatty, and at the Death Valley boundary. This report includes record sections from the ten shotpoints (Plates 2-11), a list of siesmograph locations (Appendix A), a list of shotpoint locations and shot times, DKDAT data files and Tape Grade Code (Appendix B), and a list of first-arrival traveltime picks (Appendix C). Detailed interpretation of these data will be published in a subsequent report.

7033 **(VTT-TIED—233) Estimation of the funding requirements for nuclear waste management and disposal.** Westerberg, R.; Vieno, T.; Vira, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jul 1983. 80p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE86700225.

After the active operating period the nuclear power plant must be recommissioned by the utility. According to current plans, a part of the operations pertinent to the management and disposal of reactor wastes and the spent fuel will also be left after the end of the plant lifetime. To assure the availability of adequate funds for these operations and to distribute the costs of waste management uniformly to all energy users the utilities must reserve money for the future costs during the operating period of the power plant. A reasonable basis for the estimation of funding requirements is an integrated plan for the management of all wastes from the total lifetime of the reactor. A division must then be made between those operations that are financed from the funds accrued and those included in normal power plant duties. So far the cost estimates for the nuclear waste management are obscured by significant uncertainties. To facilitate the comparison of different estimates the cost items should be split up into details as far as possible. A practical means of distributing the costs of the waste management to the energy users and to proportion the amount of funds reserved during a year to the energy users and to proportion the amount of funds reserved during a year to the amount of energy produced during that year. The decisions on different financing and funding arrangements should recognize the assurance aspects on one hand and the need for just distribution of costs on the other hand. Considering the real cost impact of the waste management, the effects of inflation and interest rates should, in addition, be taken into account.

7034 **(WIPP-DOE—96) First quarterly presentation to New Mexico's Environmental Evaluation Group on the Waste Isolation Pilot Plant.** (Westinghouse Electric Corp., Pittsburgh, PA (USA)). 1982. Contract AC04-78AL05346. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86003339.

Accomplishments include: issuance of WIPP waste acceptance criteria; issuance of Title I documents; Issuance of FEIS/Record of Decision; BLM/DOE cooperative agreement/other land withdrawal activities; completion of three key events under Draft C and C agreement; two key events in progress under Draft C and C agreement; and site and preliminary design validation site mobilization. Future activities are discussed.

7035 **(WIPP-DOE—116) Waste Isolation Pilot Plant. Site Validation Program.** (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Jan 1982. Contract AC04-78AL05346. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003397.

The six phases of the Site Validation Program Plan are covered: develop plan; evaluate WIPP site with respect to qualification criteria; establish site validation criteria conformance needs; formulate validation plan; implement validation plan; and prepare validation declaration.

7036 **(WIPP-DOE—177) Waste Isolation Pilot Plant. Quarterly Geotechnical Field Data Report.** (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Oct 1983. Contract AC04-78AL05346. 237p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86003419.

The Quarterly Geotechnical Field Data Report (GFDR) presents all the significant information obtained from the geotechnical studies at the WIPP site from June 22 through September 15, 1983 as well as all previous data collected from the geomechanical instruments. During this period, the geotechnical activities at the site to be reported were primarily concerned with monitoring of the geomechanical instruments which have been installed in the exploratory shaft and the underground drifts. Additional gas testing studies have also been performed during this period. The data presented in the GFDR reflect continuing studies, and new data will be included in future quarterly reports as it becomes available. Data evaluation and analysis are in progress and will be reported whenever results and conclusions are finalized. The Quarterly GFDR is organized into two independent parts. Part I contains all the data collected since April 1982 from the geomechanical instrumentation which have been installed inthe exploratory shaft ad underground drifts at the WIPP site. Part II presents the new drilling, testing procedures, and results associated with the continuation of the gas testing program. This program was conducted to investigate occurrences of gas primarily in the geologic strata above the roof in the WIPP underground excavation.

7037 **(WIPP-DOE—199) Quarterly Geotechnical Field Data Report.** (Bechtel National, Inc., San Francisco, CA (USA). Advanced Technology Div.). May 1984. Contract AC04-78AL05346. 517p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE86003422.

The Quarterly Geotechnical Field Data Report (GFDR) presents information obtained from the geotechnical studies at the WIPP site underground facilities from December 16, 1983, through March 15, 1984, as well as all previous data collected from the geomechanical instruments. During this period, the geotechnical activities at the site included geologic mapping in the waste shaft, core drilling in the access drifts to the experimental area, installing new instruments in drifts in the north and monitoring currently installed geomechanical instruments in the exploratory shaft and the underground drifts. The data presented in this GFDR reflect the update of continuing measurements and monitoring. Also presented in this report are preliminary data analyses and interpretations. These data analyses, which are ongoing, will continue to be reported in future quarterly reports. The GFDR is organized into two parts. The first, Geotechnical Field Data, contains all the data collected since April 1982 from the geomechanical instrumentation which have been installed in the exploratory shaft and underground drifts at the WIPP site. The second par, Evaluation and Analysis, presents preliminary data interpretation and analyses. In the analysis section, a preliminary computational analysis of a different selected location in the WIPP underground will be presented in each GFDR. For this report, a preliminary analysis of a cross section midpoint in Test Room 2 is presented.

7038 **(WIPP-DOE—213) Quarterly Geotechnical Field Data Report.** (Bechtel National, Inc., San Francisco, CA (USA). Advanced Technology Div.). Jun 1985. Contract AC04-78AL05346. 618p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE86003327.

The purpose of the Quarterly Geotechnical Field Data Reports is to meet the US Department of Energy intent to provide geotechnical and related information from WIPP underground activities to interested persons or groups in a timely manner. This Quarterly Geotechnical Field Data Report (GFDR) presents information obtained from the geotechnical studies at the WIPP site underground facilities from January 1 through March 31, 1985, as well as all previous data collected from the geomechanical intruments. During this period, the geotechnical activities at the site included geologic mapping in Room G and Room H, completion of ten additional core holes, maintaining and repairing instruments, and monitoring previously installed geomechanical instruments in shafts, underground drifts, and test rooms. The data presented in this GFDR reflect the update of continuing measurements and monitoring. Also continuing and included in this report are preliminary geotechnical and structural analyses and interpretations of the data. The GFDR is organized into two principal parts. The first part, Geotechnical Field Data, presents in graphical form all the data collected since April 1982 from the geomechanical instruments. Presented in the second part, Evaluation and Analyses, are preliminary interpretations and analyses of the data.

7039 **(YJT—84-07) Crushed aggregate-betonite mixtures as backfill material for the Finnish repositories of low- and intermediate-level radioactive wastes.** Holopainen, P.; Pirhonen, V.; Snellman, M. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Mar 1984. 68p. NTIS (US Sales Only), PC A04/MF A01. File Number DE86700222.

Backfill materials consisting of three components: crushed rock aggregate, finely ground rock aggregate and bentonite (3 to 2 per cent of weight) were studied. The production and installation procedures of the material were evaluated. Laboratory tests were made to determine the hydraulic conductivity and swelling potential of the materials. Chemical tests were made on the different materials and ground waters. Mineralogical changes of the clay fraction were estimated.

0530 ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 6989, 6993, 7034, 7049, 7838

7040 **(EGG-WM—6916) Documentation of a simple environmental pathways model of the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory.** Shuman, R.D.; Case, M.J.; Rope, S.K. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1985. Contract AC07-76ID01570. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86003250.

The DOSTOMAN code calculates compartment inventories of radioactivity for all model compartments defined. Calculations are performed for the entire period of time simulated, at user-designated intervals. This output permits tracking of radionuclide movement within and from the disposal site. Simulation runs were performed for ^{60}Co, ^{90}Sr, ^{137}Cs, ^{239}Pu, and ^{241}Am for the duration of the site's operational period. For calculational purposes only, this period was assumed to extend to the year 2093. Sensitivity analyses, in which the relative importance of biotic and abiotic transport processes in radionuclide migration was evaluated, were performed for the EDS and CDS models. Interactive effects between transport processes were examined, as were time-dependent changes in process sensitivities. Results of the analyses are useful in defining the adequacy of present environmental monitoring activities. The current monitoring program addresses all pertinent environmental media. The level of comprehensiveness in sampling each medium, however, does not reflect differences in importance of the various transport processes. A number of special studies, in progress or planned, are expected to aid in improving the monitoring program. Limitations of the DOSTOMAN model, as applied to the Radioactive Waste Management Complex, are discussed. Modeling of atmospheric and hydrologic dispersion of contaminants, and consideration of seasonal dynamics of transport processes, are identified as most deserving of attention. It is recognized that, to the extent that further refinements of the monitoring program are based on model projections, resolution of these limitations is important. Recommendations are offered for work needed to deal with these limitations, many of which are already planned for implementation.

7041 **(NUREG/CR—1289) Evaluation of isotope migration - land burial. Water chemistry at commercially operated low-level radioactive waste disposal sites. Status report through September 30, 1979.** Weiss, A.J.; Colombo, P. (Brookhaven National Lab., Upton, NY (USA)). Mar 1980. Contract AC02-76CH00016. 287p. (BNL-NUREG—51143). NTIS, PC A13/MF A01 - GPO. File Number TI86002720.

This study is designed to provide an understanding of and to monitor the behavior of existing low-level sites and to provide experimental research support to the US Nuclear Regulatory Commission (NRC) for development of criteria for the selection and licensing of solid low-level radioactive waste disposal sites. One of the significant factors in the development of these criteria is the ability to make predictions on the rate of movement of radionuclides along the ground water flow path. In cooperation with the US Geological Survey (USGS), a field and laboratory program was initiated to study the existing commercial low-level radioactive waste disposal sites. This investigation will define the source terms (concentrations in solutions) of radionuclides and other solutes in trench waters at the sites, and will describe the physical, chemical, and biological properties of the geochemical system that control the movement of radionuclides. Chapters are devoted to: the survey study of low-level radioactive waste disposal sites; trench water analysis; microbiology; and geochemical considerations.

7042 **(NUREG/CR—1862) Evaluation of isotope migration - land burial. Water chemistry at commercially operated low-level radioactive waste disposal sites. Status report, October 1979-September 1980.** Czyscinski, K.S.; Weiss, A.J. (Brookhaven National Lab., Upton, NY (USA)). Jan 1981. Contract AC02-76CH00016. 111p. (BNL-NUREG—51315). NTIS, PC A07/MF A01 - GPO. File Number TI86002685.

A field and laboratory program was initiated to study the existing commercial low-level radioactive waste disposal sites. This investigation will provide source term data for radionuclides and

other solutes in trench waters at the sites and will describe the physical, chemical, and biological properties of the geochemical system that control the movement of radionuclides. In the past year, the disposal sites at Maxey Flats, Kentucky, and Barnwell, South Carolina, were sampled, Maxey Flats for the fourth time, Barnwell for the second. Results of trench water inorganic, organic, and radiochemical analyses are similar to those reported for previous samplings. No overall systematic changes in any disposal trenches were observed during the relatively brief sampling interval. However, changes in some radionuclide and inorganic components were observed in several trenches. Tritium was the most abundant of the radionuclides and was found in all the trench waters. Analyses of water collected from a series of experimental interceptor trenches at Maxey Flats showed them to have a chemical composition intermediate between disposal trench water and local groundwater. Preliminary results of batch sorption tests using site-specific materials from the Barnwell disposal site are reported. Tritium content as a function of depth has been determined in four sediment cores collected from beneath the disposal trenches at the Barnwell facility. Gel filtration chromatography experiments using trench waters from the West Valley, New York, disposal site showed an association between ^{137}Cs and a portion of the trench water dissolved organic content (DOC). Experiments with spiked trench water (^{137}Cs and EDTA) indicated that the organic fraction referred to above was not EDTA.

7043 **(PNL—5609) MINTEQ2 geochemical code: provisionary organic data base.** Morrey, J.R.; Krupka, K.M.; Dove, F.H. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 61p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86003185.

Organic components in aqueous radioactive chemical sources, surface waters, and ground waters could substantially alter the mobility of radioactive and other important nonradioactive elements released from a defense waste disposal system. It is therefore important to be able to predict, as accurately as possible, the effects of selected organic components on the solubilities of radionuclides and important nonradioactive elements. The geochemical code MINTEQ2 can be used to assess solubilities provided that appropriate thermochemical data for organic and inorganic aqueous species and solids are available for its use. The code accepts an assemblage of gaseous and solid phases in contact with an aqueous phase and calculates the thermochemical equilibrium between these phases. Unlike typical hydrologic flow and transport codes where the data base is entirely site specific (i.e., parameters particular to the specific site), MINTEQ2 requires an additional generic thermochemical data base. This report discusses the addition of provisionary organic reactions and associated equilibrium constants to the generic data base that can be used by MINTEQ2 in scoping calculations or preliminary performance assessments.

7044 **(PNL-SA—13354) Informal discussion of United States work on uranium mill tailings.** Peterson, S.R.; Gee, G.W. (Pacific Northwest Labs., Richland, WA (USA)). Aug 1985. Contract AC06-76RL01830. 7p. (CONF-8509171—1). NTIS, PC A02/MF A01 - GPO. File Number TI85018528.

From 3. research coordination meeting of the IAEA coordinated research program; Cadarache, France (9 Sep 1985).

The environmental aspects of uranium recovery operations may be conveniently divided into three areas: (1) the interactions of ponded acidic uranium mill tailings solutions with indigenous sediments and geologic liner materials, (2) the effects of neutralization on the acidic uranium mill tailings solutions, and (3) the study of methods to minimize ground-water contamination from in situ leach uranium mining. These aspects are discussed.

7045 **(SKB-KBS-TR—84-12) Formation of nitric and organic acids by the irradiation of ground water in a spent fuel repository.** Christensen, H. (Swedish Nuclear Fuel and Waste Management Co., Stockholm; Studsvik Energiteknik AB, Nykoeping (Sweden)). Jul 1984. 24p. (STUDSVIK-NW—84-768). NTIS (US Sales Only), PC A02/MF A01. File Number DE86700217.

The formation of nitric acid has been reported in the literature, e.g. in connection with studies of glass leaching during irradiation. These experiments were carried out in order to evaluate the behaviour of glass as a matrix for highly radioactive waste. The presence of a nitrogen containing gas phase has been found to be important for the yield of the reaction. The formation of organic acids by radiolysis of carbonate solutions has been reported. The literature on the formation of organic and nitric acids have been surveyed and discussed. A conservative estimate of the formation of nitric and organic acids has been made based on dissolved nitrogen and carbonate in groundwater in a spent fuel repository. Outside a 10 cm thick copper canister containing spent fuel (the Swedish KBS-3 concept) the conservatively estimated total production of nitric, formic, and oxalic acids after 1 million years is 0.08 mol HNO_3, 0.06 mol HCOOH, and 0.04 mol $(COOH)_2$. For a thinner version of this canister with a wall thickness of only 1 cm, the conservatively estimated total production after 1 million years is 5 mol HNO_3, 4 mol HCOOH, and 3 mol $(COOH)_2$.

7046 **(SKB-KBS-TR—84-17) Dynamics of lake, bog, and bay - Consequences of exposure to man related to final storage of spent nuclear fuel.** Agnedal, P.O.; Andersson, K.; Evans, S.; Sundblad, B.; Tham, G.; Wilkens, A.B. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Dec 1984. 231p. NTIS (US Sales Only), PC A11/MF A01. File Number DE86700219.

The natural aging of the environment, much shorter than a possible continuous release from a repository, results in uncertainties as regards to consequences of exposure to man related to final storage of spent fuel. The Phase I project summarizes the identification of such factors and parameters of predominant importance for an assessment of possible radiological consequences in a normally evolving biosphere. Three major areas are described: geomorphology and residence time such as phenomena associated with the formation of lakes in Sweden formed by the latest inland ice, lake development in terms of uptake of different elements and radionuclides as a function of the chemical composition of the water in a recipient and some aspects of sedimentation in lakes and coastal waters. The chemical environment is also studied in the evolution of a lake or a Baltic bay into farming land or peat land. The most important parameters to the behaviour of trace metal ions seem to be pH, Eh, ionic strength and content of complex formers. Finally, the human impact during the evolution of a lake or a bay is discussed. The study also includes recommendation for a reference field test area and for laboratory studies of the chemical properties of radionuclides in sediments in a Phase 2 project.

7047 **(WIPP-DOE—56-Vol.2) Written comments on WIPP DEIS. Volume II: state and local.** Waste Isolation Pilot Plant. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Apr 1980. Contract AC04-78AL05346. 589p. NTIS, PC A25. File Number DE86003330.

Letters received from state and local governments regarding the Waste Isolation Pilot Plant draft environmental impact statement are reproduced.

7048 **(WIPP-DOE—209) Thirteenth quarterly presentation to New Mexico's environmental evaluation group on the Waste Isolation Pilot Plant.** (Westinghouse Electric Corp., Pittsburgh, PA (USA)). 7 Feb 1985. Contract AC04-78AL05346. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86003328.

The visual aids used in the review are presented. Topics covered include construction status, geoscience programs, ecological program, and aerosol measurement.

0540 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 6974, 7046

7049 **(CONF-8511127—2) Environmental assessments for the existing radioactive materials in the Weldon Spring raffinate pits.** Yang, J.Y.; Wang, J. (Camp Dresser and McKee, Inc., Chicago, IL (USA); Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003069.

From Conference on technology and science; Newton, MA, USA (29 Nov 1985).

Various radioactive residues (raffinates) and wastes from the processing of uranium and thorium between 1957 and 1966 are stored in four pits at Weldon Spring, Missouri. The US Department of Energy (DOE) plans to stabilize all the contaminated materials on a long-term (more than 1000-year) basis. The effectiveness of stabilization measures are evaluated by estimating radioactive releases under two options: (1) no action, and (2) improved containment using the existing raffinate pits. Two major pathways of radiation exposure are examined: (1) airborne radioactive gases and particulates, and (2) seepage into near-surface groundwater. The relative reductions of releases into the air and groundwater for a reference stabilization option (improved containment) are analyzed using mathematical models for radioactive and particulate gas fluxes and atmospheric dispersion, as well as groundwaterr transport and dispersion. The consequent health risks for nearby individuals and the general public are also evaluated. This study focuses on the migration of radionuclides under existing conditions and evaluates the effectiveness of proposed stabilization measures at the pits. Results indicate that the potential effects to the general public would be insignificant. 22 refs., 2 figs., 6 tabs.

7050 **(DOE/OT/21400—T7) Basic critical mass information and its application to Oak Ridge Gaseous Diffusion Plant design and operation.** Henry, H.F.; Mallett, A.J.; Newlon, C.E. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 23 May 1958. Contract AC05-84OT21400. 48p. (K—1019-Rev.4). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003599.

The current minimum experimental values of the basic criticality control parameters for U-235 assays between 2% and approximately 90% are presented together with the basic criticality control methods currently in effect at ORGDP. The fundamental nuclear safety criteria remain essentially unchanged from previous editions of the report with the exception of the neutron interaction specifications, which have been extended considerably, and the approval, for the first time, of the limited use of water in cascade fire control activities. A chart of the organization for nuclear safety control at ORGDP and a glossary are also included.

7051 **(GAT—1127) Investigation of Freon discharge incident cell X-33-6-8.** (Goodyear Atomic Corp., Piketon, OH (USA)). 17 Oct 1985. Contract AC05-76OR00001. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86003177.

As the result of the actuation of the rupture disk assembly a type "B" investigation was initiated in accordance with DOE Order 5484.1. The Investigation Board developed its findings through various means including interviews, examination of failed equipment, testing of controls, completion of a Management Oversight Risk Tree (MORT), Causal Factors Charting, Change Analysis, and investigation of incidents that occurred prior to and after the rupture disk actuation. On May 3, 1985, a dual rupture disk assembly actuated in the X-333 Building on the cell X-33-6-8 (even) Freon condenser. The Freon vapor discharged from the rupture disk assembly and impacted the roof, resulting in 32,400 sq. ft. of roof damage and a loss of 26,900 pounds of Freon coolant. The estimated total cost of property damage and lost Freon coolant was $150,000.

7052 **(NAK—5) Review and evaluation of foreign safety studies of the final storage of nuclear fuel waste.** Gelin, R. (National Board for Spent Nuclear Fuel, Stockholm (Sweden)). Apr 1983. 112p. (In Swedish). (STUDSVIK-NW—83-443). NTIS (US Sales Only), PC A06/MF A01. File Number DE86700212.

The studies concern final storage of nuclear fuel waste in crystalline rock. The best coverage in this report is for Canada and USA. Studies from the UK, USA, France, Switzerland and Japan are referred to. Most safety studies have resulted in very low individual doses, irrespective of assumed unfavourable values. The largest doses have emanated from iodine 129, neptunium 237, and radium 226. 84 references are given.

7053 **(NAK—9) Follow-up of foreign safety studies of final storage of nuclear fuel waste.** Gelin, R. (National Board for Spent Nuclear Fuel, Stockholm (Sweden)). Jun 1984. 43p. (In Swedish). (STUDSVIK-NW—84-701). NTIS (US Sales Only), PC A03/MF A01. File Number DE86700213.

Models and calculation programs have been developed in order to estimate the migration of radioactivity and the resulting doses. The efforts to producing reliable parameter values are increased. Safety analysis has rendered low doses. The dominant nuclides have been iodine 129, neptunium 237, technetium 99, carbon 14, and radium 226. 120 references are given.

7054 **(NAK—14) Follow-up of foreign safety studies of final storage of nuclear fuel waste.** Gelin, R. (National Board for Spent Nuclear Fuel, Stockholm (Sweden)). Apr 1985. 40p. (In Swedish). (STUDSVIK-NW—85-929). NTIS (US Sales Only), PC A03/MF A01. File Number DE86700211.

The development of mathematical models and calculation programs for estimating radionuclide migration from radioactive waste storage is continuing. Detailed site studies are in progress in the United States. The Swiss investigation which has been recently published, recommends waste storage in granite at the depth of 1200 m. The safety analysis is similar to the one of the Swedish KBS-3 study. 68 references are given.

7055 **(REG/G—3-52-Rev.1) Standard format and content for the health and safety sections of License Renewal Applications for uranium processing and fuel fabrication. Draft regulatory guide and value/impact statement. Revision 1.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Jul 1985. 52p. US Nuclear Regulatory Commission, Washington, DC 20555. File Number TI85016196.

This regulatory guide, "Standard Format and Content for the Health and Safety Sections of License Renewal Applications for Uranium Processing and Fuel Fabrication" (herein referred to as the Standard Format), has been prepared to provide more specific guidance for the preparation of the health and safety sections of license renewal applications. The Environmental Report is submitted as a separate document. The renewal application for the health and safety sections of the license consists of two major parts. The first part contains the proposed license conditions stating the performance requirements to which the applicant proposes to commit. The second part contains detailed safety information and descriptive information demonstrating the applicant's adherence to the conditions of the first part. This Standard Format is designed to separate the requirements in Part I (license conditions) from the descriptive information in Part II (demonstration and performance record).

0550 REGULATIONS

REFER ALSO TO CITATION(S) 7567, 7757

7056 **(DOE/AL/17842—T1) Analysis of the use of data elements from the Nuclear Materials Management and Safeguards System. Final report.** McMahon, A.; Stillwell, W.G. (MAXIMA Corp., Bethesda, MD (USA)). 1 Aug 1982. Contract AC04-81AL17842. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86003522.

Three general task areas were addressed in this project and two products were produced: (1) MAXIMA developed a dictionary of data elements collected and used by the Nuclear Materials Management and Safeguards System (NMMSS). This dictionary was developed as a necessary step in our understanding of the data collected for NMMSS, and thus is in a sense a by-product of the study; but it also represents a useful product in its own right that will assist the understanding of those reading this report and will, more generally, aid those who wish to understand the actual and potential uses of the system. (2) MAXIMA analyzed the relationship between specific data elements and the information products produced from NMMSS. (3) Through those information products, MAXIMA linked data elements to the report users. The method used to accomplish (2) will be discussed in more detail in later sec-

tions of this report. The information necessary for (3) was provided in reports from Union Carbide Corporation - Nuclear Division, Computer Sciences Division staff. The product of task areas (2) and (3) is a matrix that describes each data element used in the production of each report and a list of the individuals who receive that report. The remainder of this report is organized into four sections. The first briefly describes the background and history of the NMMSS and previous research studies. Section 2.0 describes the purpose of this study. Sections 3.0 and 4.0 explain the design of the study and our results, respectively.

7067 **(LA-UR—85-3735) Applications of a transportable spent-fuel measurement system.** Halbig, J.K.; Bosler, G.E.; Klosterbuer, S.F.; Rinard, P.M. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 6p. (CONF-851009—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002442.

From IEEE nuclear science symposium; San Francisco, CA, USA (23 Oct 1985).

A portable tool for making measurements on irradiated fuel has been developed to where in-plant installations having a 1 to 2% measurement uncertainty of relative exposure are feasible. The measurement uses a passive gross neutron signal and data from a gross gamma measurement as a consistency check of the neutron result and the operators declaration of cooling time. The uncertainties are about the same as those obtained using high-resolution gamma-ray techniques without the instrumentation being as obtrusive. The battery-operated microprocessor-based electronics package used with the irradiated fuel measurement system can also be used with single channel pulse counting detectors for other applications. This feature together with the large dynamic range of its current-mode ion chamber channel makes ION-I a good building block to be used in emergencies with an arsenal of detectors at a variety of nuclear plants. 8 figs., 3 tabs.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0703 ISOTOPIC POWER SUPPLIES

7068 **(MLM—3316(OP)) Failure analysis of a heat exchanger.** Merten, C.W. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). Nov 1985. Contract AC04-76DP00053. 5p. (CONF-851125—16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003733.

From American Society of Mechanical Engineers winter annual meeting; Miami, FL, USA (17 Nov 1985).

The rupture of a heat exchanger inside an inert atmosphere glovebox threatened to damage a radioactively fueled heat source intended to generate electricity on a future US space flight. Because of the potential for damage to heat sources in other gloveboxes, it was necessary to identify the cause of failure. The failure analysis was effected by listing possible causes of rupture and then determining which possibilities were consistent with evidence obtained from the failed heat exchanger. Macroscopic evaluation of the heat exchanger provided information as to the nature of the failure. Scanning electron microscopy and energy dispersive x-ray analysis were used to confirm the failure mechanism. Metallographic sections of both ruptured and deformed tubes gave clues as to the history of the material, as did microhardness measurements. Tensile tests on undeformed tubing provided estimates of strength. Burst tests on similar tubing were used to confirm the validity of the tensile data. Finally, the tensile data were used in models to determine which of the proposed scenarios of failure were most likely. It was concluded that failure had occurred because, periodically during the life of the heat exchanger, both the inlet and outlet valves had deliberately been closed. The subsequent rise in temperature caused expansion of the coolant, and a corresponding rise in hydrostatic pressure occurred which was sufficient to deform the tubing upon each repetition.

08 HYDROGEN

7059 **(BNL—36755) Overview of US contributions to IEA hydrogen technology Task IV electrolytic hydrogen production.** Mezzina, A. (Brookhaven National Lab., Upton, NY (USA)). Jun 1985. Contract AC02-76CH00016. 6p. (CONF-850799—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000026.

From 4. IEA task workshop on electrolytic hydrogen production; Julich, F.R. Germany (14 Jul 1985).

US contributions derive largely from the US Department of Energy Chemical/Hydrogen Energy Storage Systems Program. The programmatic rationale, goals and focus, which reflect current US R and D policy and perceptions, are discussed as they influence the substance and pace of the R and D program in Hydrogen Technology. Contributions and future prospects are discussed briefly.

0801 PRODUCTION

REFER ALSO TO CITATION(S) 7061

7060 **(CONF-8510162—1) Photosynthetic water splitting for hydrogen fuel synthesis.** Greenbaum, E. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000092.

From GRI basic research contractor's review meeting on gaseous fuel synthesis from inorganic resources; Chicago, IL, USA (16 Oct 1985).

Three key advances in photosynthesis research are reported. A significant advance in microalgal water splitting has been made. In the linear, low-intensity region of the light saturation curves, equivalent solar conversion efficiencies of 10% have been measured. A technological advance in the ability to genetically screen individual algal colonies has been made. Successive subcultures of anaerobiosis-stressed Chlamydomonas reinhardtii exhibited enhanced capacity for photoproduction of hydrogen and oxygen.

0804 MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 7340

7061 **(EUR—9313-Vols.1,2) Techno-economic feasibility study of the deployment of hydrogen as an energy vector. Vols. 1 and 2.** Davies, D.G.S.; Lenel, U.R.; Moore, M.A. (Commission of the European Communities, Luxembourg). 1984. 4p. Commission of the European Communities, Luxembourg.

A simulation model of hydrogen as an energy vector in competition with other fuels has been constructed and run for the countries UK, France and the Netherlands for the years 1990, 2000, 2010 and 2025. Input estimates were derived from published information and entered to the model as probability distributions. Using the AUQ (analysis with uncertain quantities) technique developed at Fulmer, the model computes output quantities for a large number of trials and provides results in the form of probability distributions. The major results of the modelling are the probabilities of hydrogen, being used as an energy vector. This probability is less than 0.4 until the year 2000, but approaches 0.6 by the year 2025. If any hydrogen is used as an energy vector, the expectation of the proportion of total energy demand supplied by hydrogen reaches about 15% by 2025. The major demands for hydrogen in this case are as road and air transport fuels. Otherwise, little hydrogen is used as an energy vector. The major supply-side results of the modelling are the expectations that no hydrogen will be produced by electrolysis and that the current steam reforming processes (of methane and naphta) will be supplemented by partial oxidation of coal and residual oil and methane catalysis from about the year 2000. The major hydrogen supply process will be methane catalysis by 2025.

0806 INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 7061

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 HYDROCARBON FUELS

REFER ALSO TO CITATION(S) 7065

7062 **(BMFT-FB-T—85-090) Basic research for the selective guidance of the Fischer-Tropsch synthesis (FTS). Phase II.** Ralek, M. (Bundesaministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technische Chemie). Sep 1985. 73p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86750494.

With 57 refs., 16 tabs., 15 figs. .

The synthesis behaviour of the manganese-iron catalyst, developed by Koelbel and Tillmetz, for the selective guidance of the Fischer-Tropsch synthesis to produce short-chained olefins was stabilized using a stochastic optimization process. In the liquid phase synthesis, yields of 50-65g C_3-C_4 olefins could be obtained per normal cubic meter of converted syngas. The product distribution corresponds to the Schulz-Flory distribution and can only be slightly influenced by technical measures applied to the reaction. The conversion of synthesis gas using mixed catalysts consisting of manganese-iron catalyst and the H-ZSM zeolite leads to hydrocarbon mixtures rich in aromatics and isomers. Based on these results, data for the direct, single-stage liquid phase synthesis of antiknock fuel were worked out. Simulations were carried out using a model and with these calculations the effect of operating parameters on the conversion and reaction performance in commercial suspension reactors can be determined. A new process variant of the Fischer-Tropsch liquid phase synthesis was developed for the direct conversion of syngas containing a very high proportion of carbon monoxide.

7063 (CONF-850297—, pp 247-266) **Development of a village level gasifier.** Grover, P.D.; Baveja, K.K.; Rao, T.R.; Iyer, P.V.R. (Indian Institute of Technology, New Delhi). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

This paper describes the development of a small village-level gasifier based on agro-residues under the Indo-US collaborative program on energy. The work consists of testing the gasifier, both water and air-cooled condensers and the gas filter (filled with various types of agro residues. Extensive testing with the engine will be carried out. 4 refs.

7064 (CONF-850297—, pp 267-299) **Development of small size gasifier: C.I. engine system for agricultural energy needs.** Mathur, H.B. (Indian Institute of Technology, New Delhi). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

A project has been undertaken to study producer gas powered small utility engines. This project is mainly involved with efficient substitution of producer gas in existing small horsepower compression ignition engines, and the effect of this substitution on engine performance, exhaust emissions, and material compatibility. This paper brings out some of the salient features of the work completed in this project so far.

7065 (CONF-850297—, pp 300-315) **Development of wood-based gasifier engine systems.** Durgaprasad, M.B.; Pandya, R.N. (Jyoti Solar Energy Institute, Vallabh Vidyanagar, Gujarat, India). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

The purpose of this project is to develop a reliable wood-based gasifier and gas cleanup system suitable to fuel C.I. engines at 5 to 30 hp, and conduct field trials for demonstrating their application in the rural areas. The project has been broadly divided into three phases, viz., Phase I: Fabrication and Testing of Field Trial Unit; Phase II: Field Implementation and Personnel Training; and Phase III: Continued Testing, Training and Documentation. A moderate number of project tasks under Phase I have been completed, and they are discussed in the report. 5 figs.

7066 (CONF-850297—, pp 316-359) **Recent operating experience with 3 kW US prototype gasifier for use in India.** Flanigan, V.; Goss, J.; Talib, A.; Bienstock, D. (Missouri Univ., Rolla; California Univ., Davis; MITRE Corp., McLean, VA; Pittsburgh Energy Technology Center, Dept. of Energy, PA). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

Several years ago, a joint effort between the Government of India and the United States Agency for International Development, was undertaken to develop biomass energy research projects for India. The principle objective of these joint projects were to develop a small gasifier system fueled with biomass residues to pump water for field irrigation. The system performs well, and simple modification will further improve the gasifier performance. An improved scrubber pump will aid in system overall performance, and a maintenance schedule will be easy to set up and monitor. The results of preliminary testing of this system are presented in this paper. 4 figs., 3 tabs.

7067 (CONF-850297—, pp 363-373) **Biomass gasification activities of GEDA.** Shah, K.S. (Gujarat Energy Development Agency, Vadodara, India). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

Research and development projects sponsored by the Gujarat Energy Development Agency (GEDA) are briefly described. They include: field demonstration of a 3.5/5 kW gasifier pump; 10 kW gasifier based reverse osmosis system; gasifier based irrigation systems; mobile gasifier units; 100 kW gasifier engine generating sets; 1000 Ha-1 MW energy plantation - power project; and gasifier engine sets as nucleus for integrated rural energy centers.

7068 (CONF-850297—, pp 397-402) **Wood gasifiers.** Mukunda, H.S. (Indian Institute of Science, Bangalore). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

The results of the investigations on the development of a 3 kW gasifier for running diesel, as well as petrol engine are reported. The effort concentrates on running both diesel and gasoline engines, because of the diversity of their use. (1) About 5 million diesel engines are used in our country. It would be possible to provide a gasifier to replace about 85% of these diesel engines. (2) For all new developments where the engine has not been installed, it would be beneficial to run a gasoline/kerosine engine, because the cost of engines are about the same and one can substitute gasoline with gas at an expense of ~30% of the power. With these twin objectives in mind, development effort of about 3 years has resulted in several novel concepts and features which are different from those of the existing systems elsewhere for this level or higher power.

7069 **(DOE/PC/50804—11) CO + H_2 reaction over nitrogen-modified iron catalysts. Quarterly technical progress report, April 1-September 30, 1985.** Delgass, W.N. (Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering). Dec 1985. Contract FG22-82PC50804. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86004169.

A 4.5 wt % supported on Carbolac - 1 catalyst was prepared by incipient wetness and characterized by in-situ Moessbauer spectroscopy. The reduced catalyst exhibited superparamagnetic iron at RT as well as extreme sensitivity to oxygen. Both of these results are indicative of small (~20A), very highly dispersed iron crystallites. After nitriding to ξ-Fe_2N followed by Fischer-Tropsch synthesis (with 3:1 H_2/CO at 250°C) for 20 hrs, the sample was re-

reduced in H_2 for 8 hrs at 400°C. The re-reduced spectrum showed that ~84% of the iron appeared to be bulk-like, indicating that the reaction environment can induce iron migration on the catalyst. Computer simulation of the decomposition of a γ-Fe_4N catalyst in hydrogen at 523 K indicates that the observed ammonia evaluation curve can be modeled by a two step process. The model incorporates a conversion from a homogeneous mixture of nitrogen in the core into a surface nitrogen species, which is subsequently hydrogenated to ammonia. The model demonstrates that competition between this nitrogen surface species and adsorbed hydrogen for the available surface sites can account for the maximum in the observed NH_3 evoluation rate. Other models incorporating shrinking core distribution of nitrogen in the core failed to fit the experimental results.

0902 ALCOHOL FUELS

REFER ALSO TO CITATION(S) 6904, 6925

7070 **(CONF-851011—6) Effect of sodium and potassium salts on the extraction of 1-butanol from aqueous solution by the ethyl esters of soybean oil fatty acids.** Compere, A.L.; Googin, J.M.; Griffith, W.L. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003094.

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The effect of 0 to 0.15 M sodium chloride, sulfate, and sulfite, and potassium acid phosphate on the extraction of 0.1 to 4.1% 1-butanol from aqueous solutions (derived from fermentation of wood pulp liquors) at 25, 40, and 55 C was evaluated using a factorial experiment. The changes in distribution coefficient were small, with mild increases occurring with increasing temperature and increasing sodium chloride, sodium sulfate, and potassium acid phosphate. Mild decreases in 1-butanol extraction occurred with increasing sodium sulfite. 6 refs., 4 tabs.

7071 **(DOE/CS/80010—T9) TVA/DOE Integrated Onfarm Alcohol Production System Alternate Feedstock Evaluations.** Cox, R.J. (comp.). (Tennessee Valley Authority, Muscle Shoals, AL (USA). Office of Agricultural and Chemical Development). Sep 1985. Contract AI01-80CS80010. 100p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86003905.

The purpose of this Interagency research project is to study the feasibility of small-scale fuel alcohol production from agricultural crops. The project was conducted in three phases. Phase I included an assessment of the potential for fuel alcohol production from agricultural crops and design, construction, and startup operation of a 10-gallon-per-hour evaluation facility. Phase II included validation and optimization of the facility with a corn feedstock, modifications to the base unit to accommodate nongrain feedstocks, initial production and conversion evaluations of nongrain feedstocks, and preparation of a construction and operation manual. Phase III included further evaluations and refinement of processes and equipment for handling nongrain feedstocks, evaluation of stillage by-products as feeds, and development of agricultural systems for integrating alcohol production with other farm enterprises. This report provides: (1) a brief background of Phase I-III activities; (2) results of alternate feedstock choices, cultural trials, and testing results; (3) a description of the process for ethanol production from starch and sugar feedstocks; and (4) conversion procedures, sterilization requirements, and distillation methods for several feedstocks. 23 refs., 8 figs., 25 tabs.

0904 SOLID WASTE AND WOOD FUELS

REFER ALSO TO CITATION(S) 6931, 7418, 7687

7072 **(CONF-840852—Pt.1) Biomass fuel drying conference proceedings. Part 1.** (Forest Service, St. Paul, MN (USA). North Central Forest Experiment Station; Council of Great Lakes Governors, Inc., Madison, WI (USA); Fiber Fuels Inst., St. Paul, MN (USA); Minnesota Univ., St. Paul (USA). Dept. of Agricultural Engineering; Forest Products Research Society, Madison, WI (USA); Society of Wood Science and Technology, Madison, WI (USA)). 8 Aug 1984. Contract FG05-83OR21390. 124p. NTIS MF A01; 2; GPO Dep. File Number DE85008377.

From Fiber Fuels Institute summer trade show and technical conference; Superior, WI, USA (7 Aug 1984).

Papers presented at the Conference are included in this document. Topics include: utilization of wood waste as a fuel for rotary and flash tube wood dryers; air drying trials; drying corncobs as a fuel for corn drying; compression drying to increase the value of forest residue for energy; forest residue fuel predrying-economic analysis; industrial applications for new steam drying process in forest and agricultural industries; and peat drying. Separate abstracts have been prepared for each paper for inclusion in The Energy Data Base.

7073 (CONF-840852—Pt.1, pp 1-16) **Utilization of wood waste as fuel for rotary and flash tube wood dryer operation.** Fredrikson, R.W. (MEC Co., Neodesha, KS). 8 Aug 1984. NTIS MF A01. File Number DE85008377.

From Fiber Fuels Institute summer trade show and technical conference; Superior, WI, USA (7 Aug 1984).

The twofold impetus of economic and ecological considerations has brought the use of waste wood fuels in wood drying operations out of its experimental infancy stages into what is currently a totally viable and practical alternative to using conventional fuels. This paper touches on some of the earlier successes and failures leading to today's current state-of-the-art technology in wood-fired drying system design. This technology is briefly presented with respect to general categories of heat sources, their advantages and limitations and their relative compatibility with rotary and flash dryer system design criteria. Particular areas of concern, including control system integration, turndown and response time capabilities, emissions and product contamination and auxilliary startup or standby heat source requirements are discussed. Examples of systems in operation and under construction which reflect current technology are presented and future potentials are also discussed. The paper is concluded by emphasizing the importance of initial attention to complete integrated system design in order to attain a successful final operation.

7074 (CONF-840852—Pt.1, pp 17-35) **Ambient air drying trials - chunkwood versus chips.** Sturos, J.B. (North Central Forest Experiment Station, Houghton, MI). 8 Aug 1984. NTIS MF A01. File Number DE85008377.

From Fiber Fuels Institute summer trade show and technical conference; Superior, WI, USA (7 Aug 1984).

The results of experiments to determine the best method for air drying piles or layers of wood chunks and wood chips are presented. The first experiment used natural convection air drying indoors; the second used forced air drying indoors; the third used storage cribs and natural outdoor air drying. Test results indicate that wood chunks dried faster than wood chips when using natural convection air flow both indoors and outdoors. Chips dried faster using forced air drying but required 8 to 12 times more pressure to force the air through consuming 44 to 74% more energy. 11 refs., 12 figs., 1 tab. (DMC)

7075 (CONF-840852—Pt.1, pp 36-41) **Drying corncobs as a fuel for grain drying.** Morey, R.V. 8 Aug 1984. NTIS MF A01. File Number DE85008377.

From Fiber Fuels Institute summer trade show and technical conference; Superior, WI, USA (7 Aug 1984).

A potential system for use of corncobs as a fuel for drying grain is evaluated. The system includes collecting, transporting,

processing (size reduction), drying, gasification and/or combustion of corn cobs. The emphasis in this paper is on methods for drying. Schematics are included. 1 ref., 4 figs. (DMC)

7076 (CONF-840852—Pt.1, pp 42-54) **Compression drying to increase the value of forest residue for energy.** Steklenski, P.; Haygreen, J. 8 Aug 1984. NTIS MF A01. File Number DE85008377.

From Fiber Fuels Institute summer trade show and technical conference; Superior, WI, USA (7 Aug 1984).

Preliminary findings are presented concerning the physics of compression drying of wood chips for use as fuels. Results show that: (1) A significant portion of the free water in green wood chips can be removed with the application of ram face pressures in the range of 500 to 13,000 psi. (2) The effect of ram face pressure on moisture reduction decreases in effectiveness as pressure increases. Thus, there is a point (perhaps in the 3000 to 8000 psi range) where application of additional pressure is probably not justified. (3) Compression drying of wood chip mats is obviously a time dependent process. It is likely that the time dependency depends on the size of the chip mat, which determines the distance of water flow. 3 refs., 11 figs., 1 tab.

7077 (CONF-840852—Pt.1, pp 55-88) **Forest residue fuel pre-drying, economic analysis.** Frea, W.J. (Michigan Technological Univ., Houghton). 8 Aug 1984. NTIS MF A01. File Number DE85008377.

From Fiber Fuels Institute summer trade show and technical conference; Superior, WI, USA (7 Aug 1984).

Pre-drying of forest residue fuel was compared economically with direct burning of green wood fuel in a modern boiler using heat recovery equipment. Heat sources for the pre-drying were obtained from unheated forced air, natural air circulation during storage, and boiler flue gas. Two cases were considered, the conversion of an existing boiler to wood fuel, and the purchase of a new wood fired boiler. Estimated return on investment was calculated for four systems each incorporating a different pre-drying heat source. It was indicated that a good return on investment could be obtained with two of the systems, one using unheated forced air drying, and the other using natural drying in storage. Less promising was a system with baled wood chips which was hampered by requiring large drying times and bale typing wire costs. Another system, having boiler flue gas heated pre-drying of 50% moisture content wood chips, was not economically favorable when compared with the alternative of using the flue gas to pre-heat combustion air and boiler feed water. The results may aid in designing an optimum system for steam generation from forest residues. 17 refs., 4 figs., 4 tabs.

7078 (CONF-840852—Pt.1, pp 89-112) **Industrial applications for new steam drying process in forest and agricultural industries.** 8 Aug 1984. NTIS MF A01. File Number DE85008377.

From Fiber Fuels Institute summer trade show and technical conference; Superior, WI, USA (7 Aug 1984).

This paper describes a system whereby dried material and steam are separated in a cyclon and the steam is recirculated. The excess steam generated during drying is continuously bled off from the system. Thus, if material is dried from 45 to 50% dry content to 85 to 90%, about 1 ton of steam per ton of material is generated in the dryer. This steam is available as process steam at a pressure of 2 to 6 bar. Alternatively, generated steam can be used as heating steam for the dryer after passing a vapour compressor. 9 figs., 1 tab.

7079 (CONF-850297—, pp 127-136) **Combustion of biomass in an atmospheric fluidised bed combustor.** Vasudevan, R. (Bharat Heavy Electricals Ltd., Tiruchirapalli, India). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

This paper describes the process of fluidized-bed combustion and the use of this technology for the conversion of the agricultural wastes of India into usable forms of energy. (DMC)

13 HYDRO ENERGY

7080 (DOE/R0/00481—T1) **Cascadian farm small hydro project. Final performance report.** (Cascadian Farm, Rockport, WA (USA)). 1982. Contract FG06-80R000481. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000460.

The first year of this hydroelectric project was spent in obtaining the necessary permits and in pipeline and road construction. The intake, drainage, and powerhouse are also discussed. Maximum power is 80 to 90 kW. (DLC)

7081 (DOE/R0/00542—T1) **Integration of hydroelectric power and apiary management. Final report.** Mitchell, C. (Coastal Petroleum Associates, Baton Rouge, LA (USA)). 19 Jun 1983. Contract FG06-80R000542. 5p. (OR—80-027). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000449.

Appropriate Technology Grant 3-80-342 is an attempt to integrate hydroelectric power with apiary management. The biggest challenge to the efficient completion of the project was connecting with the appropriate technology and associated personel to guide the project. Most of the so called "experts" in this field are at an early experimental stage in technology and knowledge. The existing system is capable of generating ample electricity six to seven months out of the year. The unit was operating consistantly near the end of winter. At present, it is not running due to lack of sufficient water.

7082 (DOE/R1/10027—T1) **Hydro redevelopment in east Machias: a community energy project.** (East Machias, Town of, ME (USA)). 1980. Contract FG41-79R110027. 79p. (ME—79-002). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86000373.

The town of East Machias in Maine seriously considered the redevelopment of their hydro station during the summer of 1978. A grant from the Coastal Zone management program enabled the preparation of a preliminary feasibility report which addressed economic, environmental, engineering, and resource management issues. The results of that study indicated that the project was both economically and technically feasible and that more detailed investigations should be conducted before making any decisions on project implementation plans. The next phase of studies was assisted by the approval of two grants from the DOE Appropriate Technology program and Coastal Energy Impact Program (CEIP) administered through NOAA. The DOE grant was used to complete the following tasks: secondary phase of engineering; economic analysis; opportunity for public involvement; refinement of resource management plan; and preparation of federal and State of Maine license applications. This report summarizes the results of these different study elements. However, the project was terminated at a town meeting.

1303 PLANT DESIGN AND OPERATION

7083 (DOE/R2/05006—T1) **[Project to produce hydroelectric power.] Final report.** Pietri, J.M. (Pietri (Jose M.), Yauco (Puerto Rico)). [1986]. Contract FG42-79R205006. 11p. (PR—79-010). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000509.

The purpose of the project is to use the water current of the Prieto River in Yauco, Puerto Rico, to produce hydroelectric power. The water flow in a 1000-ft long by 2 ft wide channel, moves an hydraulic wheel and a 20-kW generator. The electricity is used to process coffee.

7084 (NP—6770043) **Algorithms for the digital speed regulation of hydraulic turbines.** Mueller, H.W. (Bochum Univ. (Germany, F.R.). Lehrstuhl fuer Mess- und Regelungstechnik). Jul 1984. 161p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE86770043.

This paper deals with the problem of speed regulation of hydraulic turbines. In particular, it is intended that attention should be drawn to the possibilities of improving regulation behaviour by in-

stalling a microcomputer regulator. The paper is divided into 4 sections. In the first section a mathematical model for a hydro-electricity plant with a Francis turbine is derived. The model consists of 4 sub-models: works water pipe, turbine, generator network and regulator. The non-linear differential equations which describe the submodels of the overall system, are given. From this and in the second section, the respective transfer functions are determined. The third section deals with the basic construction of a conventional turbine regulator and also with is various functions as a primary and secondary regulator. The object of the 4th section is the design of speed regulators for hydraulic turbines. For a long time this was limited to the empirically investigated adjustment regulations. After a short discussion of the application of the frequency response characteristic method for control synthesis, several methods for designing compensation regulators are introduced. In this regard, an interesting method for choosing optimally the zero setting of a transfer function is derived. This may be used in various exercises.

1306 ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 7839, 7840

7085 **(DOE/BP/11902—1) Enloe Dam Passage Project. Annual report 1984. Volume I.** Fanning, M.L. (IEC Beak Consultants Ltd., Richmond, British Columbia (Canada)). Jul 1985. Contract AC79-83BP11902. 313p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE86004191.

This report discusses issues related to the provision of fish passage facilities at Enloe Dam and the introduction of anadromous salmonid fish to the upper Similkameen River basin. The species of fish being considered is a summer run of steelhead trout adapted to the upper Columbia basin. (ACR)

7086 **(DOE/BP/13102—1) Deschutes River Spawning Gravel Study. Volume I. Final report.** Huntington, C.W. (Buell and Associates, Inc., Beaverton, OR (USA)). Sep 1985. Contract AC79-83BP13102. 259p. NTIS, PC A12/MF A01. File Number DE86003923.

Spawning habitat in the Deschutes River was inventoried, gravel permeability and composition were sampled at selected gravel bars, historical flow records for the Deschutes were analyzed, salmon and trout utilization of spawning habitat was examined, and potential methods of enhancing spawning habitat in the river were explored. Some changes in river conditions since the mid-1960's were identified, including a reduction in spawning habitat immediately downstream from the hydroelectric complex. The 1964 flood was identified as a factor which profoundly affected spawning habitat in the river, and which greatly complicated efforts to identify recent changes which could be attributed to the hydrocomplex. A baseline on present gravel quality at both chinook and steelhead spawning areas in the river was established using a freeze-core methodology. Recommendations are made for enhancing spawning habitat in the Deschutes River, if it is independently determined that spawning habitat is presently limiting populations of summer steelhead or fall chinook in the river. 53 refs., 40 figs., 21 tabs.

7087 **(DOE/BP/13102—2) Deschutes River Spawning Gravel Study. Volume II. Appendices I-XIV. Final report.** (Buell and Associates, Inc., Beaverton, OR (USA)). Sep 1985. Contract AC79-83BP13102. 429p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE86003920.

Spawning habitat in the Deschutes River was inventoried, gravel permeability and composition were sampled at selected gravel bars, historical flow records for the Deschutes were analyzed, salmon and trout utilization of spawning habitat was examined, and potential methods of enhancing spawning habitat in the river were explored. Some changes in river conditions since the mid-1960's were identified, including a reduction in spawning habitat immediately downstream from the hydroelectric complex. The 1964 flood was identified as a factor which profoundly affected spawning habitat in the river, and which greatly complicated efforts to identify recent changes which could be attributed to the hydrocomplex. A baseline on present gravel quality at both chinook and steelhead spawning areas in the river was established using a freeze-core methodology. Recommendations are made for enhancing spawning habitat in the Deschutes River, if it is independently determined that spawning habitat is presently limiting populations of summer steelhead or fall chinook in the river. Volume II contains appendices to the study.

7088 **(DOE/BP/27780—1) Radio-tracking studies of adult chinook salmon and steelhead to determine the effect of "zero" river flow during water storage at Little Goose Dam on the lower Snake River. Final report.** Liscom, K.; Stuehrenberg, L.; Ossiander, F. (National Marine Fisheries Service, Seattle, WA (USA). Coastal Zone and Estuarine Studies Div.). Sep 1985. Contract AI79-81BP27780. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86003962.

Allowable instantaneous minimum river flows are established in the Columbia and Snake Rivers to ensure safe passage of anadromous fish during their migration to the spawning grounds. However, water storage during periods of low power demands (at night and on weekends) would be beneficial to the power producers. This storage procedure is called "zero" river flow and is now permitted on a limited basis when there are few if any actively migrating anadromous fish present in the river system. Requests were made to extend "zero" river flow into periods when anadromous fish were actively migrating and a study was initiated. Radio-tracking studies were conducted on the Snake River between Lower Monumental and Little Goose Dams to determine the effect of "zero" river flow on the migration of adult chinook salmon, Oncorhynchus tahawytscha, and steelhead, Salmo gairdneri. From July through September, 1981, a total of 258 steelhead and 32 chinook salmon were radio-tagged. The rate of migration was used to determine differences between test and control fish and a gamma distribution model was used to describe the migration rate for radio-tagged fish. Estimates of the parameters of the model were used to statistically compare "zero" flow and normal river flow conditions for the radio-tagged fish. The results show that the "zero" flow condition delays the migration of adult chinook salmon and steelhead; therefore, extended periods of "zero" flow to store water are not recommended when fish are actively migrating in the river system. 16 refs., 5 figs., 9 tabs.

14 SOLAR ENERGY

7089 **(CONF-830622—Pt.4) Progress in solar energy. Volume 6. Engineering Division.** (American Solar Energy Society, Boulder, CO). Jun 1983. Contract FG03-83SF11947. 405p. NTIS, PC A18/MF A01; 1; GPO Dep. File Number DE86000189.

From American Solar Energy Society meeting; Minneapolis, MN, USA (1 Jun 1983).

Solar heating and cooling systems, solar collectors, and solar thermal power are the major topics of these presentations. Each report has been separately indexed for inclusion into the Energy Data Base. (BCS)

7090 **(CONF-830622—Pt.5) Progress in solar energy. Volume 6. International Interests Division.** (American Solar Energy Society, Boulder, CO). Jun 1983. Contract FG03-83SF11947. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86000190.

From American Solar Energy Society meeting; Minneapolis, MN, USA (1 Jun 1983).

Some international interests in the use of solar energy are found in these presentations. Each report has been separately indexed for inclusion into the Energy Data Base. (BCS)

7091 **(CONF-830622—Pt.6) Progress in solar energy. Volume 6. Passive Systems Division.** (American Solar Energy Society, Boulder, CO). Jun 1983. Contract FG03-83SF11947. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86000191.

From American Solar Energy Society meeting; Minneapolis, MN, USA (1 Jun 1983).

A total of 18 presentations on the subject of passive solar systems are included. Each report has been separately indexed for inclusion in the Energy Data Base. (BCS)

7092 **(CONF-830622—Pt.7) Progress in solar energy. Volume 6. Socio-Economics Division.** (American Solar Energy Society, Boulder, CO). Jun 1983. Contract FG03-83SF11947. 103p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86000192.

From American Solar Energy Society meeting; Minneapolis, MN, USA (1 Jun 1983).

The socio-economics of using solar energy systems is studied in these presentations. Each report is separately indexed for inclusion in the Energy Data Base. (BCS)

7093 **(CONF-830622—Pt.8) Progress in solar energy. Volume 6. Solar Radiation Division.** (American Solar Energy Society, Boulder, CO). Jun 1983. Contract FG03-83SF11947. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86000193.

From American Solar Energy Society meeting; Minneapolis, MN, USA (1 Jun 1983).

Studies on the measurement and forecasting of solar radiation are presented. Indexing has been performed for each individual report for inclusion in the Energy Data Base. (BCS)

1401 RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 7093, 7823

7094 **(EUR—9259) Studies on the measurements of solar radiation.** Gregor, J.Mc. (Commission of the European Communities, Luxembourg). 1984. 11p. Commission of the European Communities, Luxembourg.

The programme of work at Cardiff is split into two main areas of interest, (1) pyranometer characteristics and (2) radiation data processing. The progress in each of these areas is described in the following.

7095 **Global transmissivity and diffuse fraction of solar radiation for clear and cloudy skies as measured and as predicted by bulk transmissivity models.** Carroll, J.J. (Land, Air and Water Resources, University of California, Davis, CA). *Solar Energy;* **35**: No. 2, 105-118(1985).

Measurements of cloudiness and of global, direct, and diffuse radiation taken over a 13 mo period at Davis, CA, are analyzed in terms of global transmission (K /SUB t/) and diffuse fraction (K / SUB d/) for clear sky conditions and for various cloudiness conditions. A number of global transmission clear sky models are compared with observations for ranges of total water column and turbidity and some are found to give representative values for the global radiation at the ground. The dependence of the diffuse fraction on global transmission is found to be best represented by linear formulae-with different dependencies found for clear and cloudy conditions. Global transmission models are also compared with observations for cloudy conditions and found to give representative values of cloud transmissivities if climatological differences in the cloudiness at the measurement site and those sites used to calibrate the cloud models are considered. These results support the use of routine instantaneous surface meterological data to calculate the most likely instantaneous global and diffuse radiation on a horizontal surface in the absence of any radiation measurements. These calculated irradiances are best used for solar energy system dynamic modeling in which system responses to typical sequences in meterological conditions are being examined.

1405 SOLAR ENERGY CONVERSION

REFER ALSO TO CITATION(S) 6886, 7060, 7063, 7066, 7067, 7068, 7070, 7071, 7072, 7073, 7074, 7075, 7076, 7077, 7078, 7079, 7111, 7169, 7323, 7515, 7528, 7598, 7687, 7778, 7865

7096 **(BMFT-FB-T—85-084) Amorphous silicon solar cells. Phase II.** Guenzel, E.; Juergens, W.; Kausche, H.; Kruehler, W.; Kusian, W.; Moeller, M.; Peters, W.; Pfleiderer, H.; Plaettner, R.; Rauscher, B. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.). Forschungslaboratorien). Sep 1985. 179p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE86750486.

The continuation of our work led to some important results. The objective of an efficiency of about 10% has been reached. For small cells of the type glass/SnO_2/p-SiC:H/i,n-aSi:H/Ag best values lie at 9,8% (AM1). Best single values for open circuit voltage, short circuit current and fill factor were Usub(OC)=900 mV, Isub(SC)=18,4 mA/cm^2 and FF=68% for a cell area of 6 mm^2. With starting of a large multi-chamber in line plant we could manufacture homogeneous a-Si:H layers 30 cm x 30 cm in size with good photoconductivity and cells of 10 cm x 10 cm. The efficiency of these large cells is now about 5%. Prerequisit for these results was the development of a high quality a-Si:H-material with a density of states of about $10^{16}cm^{-3}\,eV^{-1}$ (SCLC) and a diffusion length of proportional 0,3 μm. Furthermore an a-Si:H-material was developed that shows at a bandgap of 2,1 eV an activation energy of about 0,3 eV after boron doping. A variety of resulting material and cell knowledge in substrates, TCO layers, μc-silicon, influence of impurities, doping, pinholes, back electrodes represent the basis of our work, decisively supported by specially adapted measurement (spectral response, SPV, FE, SCLC, C/U).

7097 **(BMFT-FB-T—85-096) Development of thin-film solar cells based on amorphous silicon.** Mueller, G.; Winterling, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1985. 72p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86750498.

This project was aimed to develop a-Si solar cells with an improved efficiency and to determine the characteristics of these cells. Mainly cells with p-i-n-structure were deposited by decomposition of SiH_4 in a radio-frequency glow discharge. The main results are: SS/p-i-n/ITO cells having 5% AM-1 efficiency at an area of 16 cm^2; glass/SnO_2/p-i-n/Al cells with areas < 1 cm^2 having AM-1 efficiencies up to 6%. The cell stability under prolonged illumination was found to depend on firstly the deposition conditions of the a-Si:H material and secondly on whether the light is entering through the p^+- or n^+ layer. Cells with an initial efficiency of 4.5% suffered a decrease of efficiency to 0.94 of its initial value after 400 hours of AM-1 illumination. The cells developed in this project possess properties sufficient to provide power for small-scale applications such as in pocket calculations. However, more progress is needed in efficiency, long-time stability and a-Si deposition rate before a-Si cells become economically useful for power applications.

7098 **(CONF-8509190—1) Use of trinitrobenzene sulfonate to determine the pK/sub a/ values of two active-site lysines of ribulosebisphosphate carboxylase/oxygenase.** Hartman, F.C.; Milanez, S.; Lee, E.H. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Oak Ridge (USA). Graduate School of Biomedical Sciences). 1985. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002274.

From American Protein Chemists symposium; San Diego, CA, USA (30 Sep 1985).

An investigation into the active site of ribulosebisphosphate carboxylase using trinitrobenzene sulfonate to determine the pKa of lysine residues. 43 refs., 7 figs., 1 tab.

7099 **(DOE/JPL/957175—2) Rapid thermal processing of ion implanted silicon as a viable solar cell technology. Quarterly report, August-October 1985.** Rozgonyi, G.A. (North Carolina State Univ., Raleigh (USA). Dept. of Materials Engineering). 15 Oct 1985. Contract NAS-7-100-957175. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003427.

Results are presented on 20 silicon wafers whose interstitial oxygen concentration has been measured before and after furnace treatments and/or rapid thermal processing (RTP). A lithium diffusion furnace has been designed and built. Generation lifetime maps have been obtained on two wafers. (LEW)

7100 **(EUR—9841-EN) Technology of thin-layer-silicon solar cells and applications to power systems.** Thanailakis, A.; Antonopoulos, J.G.; Girginoudi, D.; Abarian, P.; Vachtsevanos, G.; Kalaitzakis, K.; Gribas, E. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 96p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

This research work consists of two major areas and the results obtained are summarised as follows: Part I. The aim was to develop thin film a-Si:H solar cells, but due to uncontrolled reasons the work was restricted to a-Si solar cells. Vacuum deposited layers, of thickness 0.2-1.4 μm on different substrates held at various temperatures, studied by TEM were found to be amorphous. At 550-580°C these a-Si layers were converted into poly-Si. The room temperature I-V characteristics of Al and Au Schottky diodes on n-type, p-type and near intrinsic a-Si layers, evaporated on stainless steel and Al covered glass substrates held at room temperature, are significantly different, their differences being similar to those of Al and Au diodes on single crystalline silicon. When the same diodes were formed on poly-Si, produced by heating a-Si at 550-600°C, the I-V characteristics were very much improved. Part II. The second major area of the project refers to the design, construction and testing of appropriate power conditioning and interface equipment for the parallel operation of PV power systems and the utility grid. Here, our effort focused upon the design and construction of a line-commutated dc to ac inverter for the parallel operation of a PV system with the utility grid.

7101 **(EUR—9843-EN) High concentration PV 100 W module making use of spectral splitting Si-GaAs coupled cells.** Fanetti, E.; Flores, C.; Guarini, G.; Paletta, F. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 100p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

In the present report the activity concerning the design and fabrication of a small size, high concentration module using GaAs and GaAlAs cells is described. The aim of the work was that of checking of maturity of GaAs technology for solar cells, making experience on very high concentration and demonstrating the feasibility of multicell solutions using spectrum splitting optical filters. In theory, the bandgap combination (1.7 eV-1,1 eV) corresponding to GaAlAs and Si solar cells is nearly the optimum, but no high efficiency Si cells specifically designed and optimized for spectrum split applications could be supplied by other laboratories. The combination of GaAs (1,4 eV) and GaAlAs (1,7 eV) was therefore chosen and high efficiency cells designed and fabricated in CISE were used. The module includes six Fresnel lenses, six solar cell couples with spectrum splitting filters, a full tracking structure, an active cooling circuit and a maximum power tracking circuit. All the principal components, such as cells and optical elements, have been individually characterized up to 1000 suns concentration ratios. For Fresnel lenses, the energy distributions as a function of the distance from the lens, have been measured. The transmission curves of the splitting filters have been measured as well. All the individual cells have been characterized in full spectrum demonstrating an average conversion efficiency at 800 suns AM1.5 of 18% for the GaAs cells and 16.5 for the GaAlAs cells.

7102 **(SERI/SP—271-2589) Solar Energy Computer Models Directory.** (Solar Energy Research Inst., Golden, CO (USA)). Aug 1985. Contract AC02-83CH10093. 137p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85008791.

This directory describes models developed and available in the US for six solar and renewable energy technologies: biomass; solar heating, cooling, and conservation; ocean energy; photovoltaics; solar thermal; and wind.

7103 **Photocapacitance of CdZnS/CuInSe$_2$ thin-film heterojunctions.** Ahrenkiel, R.K. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, Colorado 80401). *Journal of Applied Physics;* **59**: No. 1, 181-185(1 Jan 1986).

The photocapacitance of a thin-film CdZnS/CuInSe$_2$ heterojunction was observed under white light excitation. Capacitance increases were observed that were indicative of minority-carrier trapping in the junction. Emission spectroscopy indicated that a distribution of traps produce this signal. Analysis of the data indicate trap distributions ranging from 5×10^{14} cm^{-3} to 1.6×10^{18} cm^{-3} in the bulk and 3.3×10^{11} cm^{-2} at the surface. Photovoltaic efficiency was inversely related to the photocapacitance signal. A model relates deep electron interface states to a decrease in open-circuit voltage.

7104 **Chemical vapor deposition of hydrogenated amorphous silicon.** Kurtz, S.R.; Proscia, J.; Gordon, R.G. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138). *Journal of Applied Physics;* **59**: No. 1, 249-256(1 Jan 1986).

Hydrogenated amorphous silicon films are made by atmospheric pressure chemical vapor deposition from polysilanes between 430 and 480°C. The films have hole diffusion lengths up to 0.4 μm, as measured by the surface photovoltage technique. Oxygen impurities are shown to reduce the diffusion length. Stainless-steel and crystalline silicon substrates give slightly different results, implying that contamination is introduced by the substrates.

7105 **Characterization of high-efficiency silicon solar cells.** Green, M.A.; Blakers, A.W.; Osterwald, C.R. (Solar Photovoltaic Laboratory, Joint Microelectronics Research Centre, University of New South Wales, Kensington, Australia 2033). *Journal of Applied Physics;* **58**: No. 11, 4402-4408(1 Dec 1985).

Preliminary results on silicon solar cells of improved performance recently have been described. The present paper describes the results of a more detailed optical and electrical characterization of these devices. The high performance of the cells is shown to be due to a high optical efficiency and near ideal junction characteristics combined with low parasitic resistance losses.

7106 **Localized photoelectrochemical measurements of passive filmson titanium.** Butler, M.A. (Sandia National Laboratories, Albuquerque, NM). *Journal of the Electrochemical Society;* **130**: No. 12, 2358-2362(Dec 1983).

Using a focused laser and a digitally controlled x-y stage, localized photoelectrochemical measurements have been made on 100A thick passive films on polycrystalline titanium. The photocurrent dependence on potential is semiquantitatively explained by a model considering trap dominated electronic charge transport in the passive film. Variations in the measured electronic properties are observed which correlate with the underlying metal grain structure. The data suggest extremely high trap densities in the passivating film.

1406 PHOTOVOLTAIC POWER SYSTEMS

REFER ALSO TO CITATION(S) 7090, 7100, 7102

7107 **(BMFT-FB-T—85-081) 100 kWp solar power station.** Mickal, H.; Ritter, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Siemens A.G., Erlangen (Germany, F.R.). Abt. Automatisierungstechnik). Aug 1985. 89p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE86750485.

The consortium, consisting of SIEMENS AG, VARTA AG and the Public Power Corporation (PPC) Athens - designed, erected and comissioned on time (30.06.83) on the Greek Cyclades island Kythnos solar power plant - belonging to the solar program set up by the European Communities - with a peak power rating of 100 kW. Aim of the work was - by feeding of the electrical energy generated by the photovoltaic power-station into the island's isolated power supply system that was originally fed solely from diesel generators and since middle of 1982 additionally by five wind power plants each rated for 20 kW - to reduce the load on the diesel generators thus saving maintenance and fuel costs.

7108 **(DOE/SF/11997—T1) Photovoltaic driven vapor compression cycles. Final technical report.** Anand, D.K. (TPI, Inc., Bethesda, MD (USA)). [1985]. Contract AC03-84SF11997. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001702.

Since the vast majority of heat pumps, air conditioning and refrigeration equipment employs the vapor compression cycle (VCC) the use of renewable energy represents a significant opportunity. As discussed in this report, it is clear that the use of photovoltaics (PV) to drive the VCC has more potential than any other active solar cooling approach. This potential exists due to improvements in not only the PV cells but VCC machinery and control algorithms. It is estimated that the combined improvements will result in reducing the PV cell requirements by as much as one half.

7109 **(EUR—9039) Electrical car using solar energy.** (Commission of the European Communities, Luxembourg). 1984. 4p. Commission of the European Communities, Luxembourg.

It has been implemented on the Heverlee campus of the University of Leuven and consists mainly of an array, a test cabin and an electric car. The array was entirely made in the ESAT laboratory, using its original integral screen printing technique for the cells. For several reasons the electric car chosen was the PGE 5P TAXI (Milano, Italy). Out of the daily performed measurements during the months of July and August, we could conclude the following: - the reliability of the array and the loading system appeared to be very good, - the system efficiency is relatively low. This is due to several reasons: - the loading voltage is not always equal to the optimum voltage Vm, - the interconnection of several modules results in a decreasing total efficiency (it is determined by the worst module), - the temperature rises during the day (giving a lower efficiency), - the poor condition of the batteries resulted in a practical range of no more than 30 km. We can conclude that solar electricity is for the moment only economically viable for small-scale purposes in remote areas. As a general conclusion we can state that the technical possibility of the project is proven, yet there can still be done a lot of work on increasing the reliability of electric cars.

7110 **(EUR—9414) Qualification test procedures for photovoltaic modules. Specification No. 502 Issue 1.** Krebs, K. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1984. 47p. Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg.

This document lays down test specifications for photovoltaic module control tests performed by the Joint Research Centre of the Commission of the European Communities for the qualification of modules for photovoltaic projects funded by the Commission. It contains the test schedule and a detailed description of 15 control tests. The purpose of these tests is to provide data on the performance rating of photovoltaic modules and to identify environmental factors and design features which could affect their durability.

7111 **(EUR—9957-EN) Feasibility study for small solar cell operated units in Greece.** Soras, K.; Makios, V. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 172p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

This study concerns itself with the applicability of small (up to 5 KWp) stand alone photovoltaic systems. At first, a list of all candidate applications was formed and all the corresponding potential users were interviewed. Furthermore, the most common conventional systems used today, which are the utility grid extension and the use of small diesel generators, were examined. A computer program was developed to select the optimum size of the PV system and was used to evaluate the most promising applications, in detail. A basic result of the computer program formulation is that the battery size is much more sensitive than the array size, and depends on the battery and the power conditioning unit efficiencies. The most developed market today in Greece is that of the use of photovoltaics in lighthouses. A number of PV powered rural telephones has been already installed, mainly on the islands. While for small loads, such as TV-FM repeaters, the break even to the utility grid extension occurs for less than 1.5 Km, such systems have not yet been installed. Several PV powered seismic sensors have been also installed and also a few systems on medium size sailboats. The most promising application, though, is the use of photovoltaics on remote houses to cover basic electric needs (i.e. lighting, refrigeration and pumping).

1407 SOLAR THERMAL POWER SYSTEMS

REFER ALSO TO CITATION(S) 7089

7112 **(DOE/SF/10499—T9-Rev.) 10 MWe Solar Thermal Central Receiver Pilot Plant: solar facilities design integration. Purchaseddemineralized water technical requirements specification (RADL Item 7-12A). Revision.** (Stearns-Roger Corp., Denver, CO (USA)). Sep 1980. Contract AC03-79SF10499. 59p. (STMPO—214-Rev.; SAN—0499-61-Rev.; MDC-G—8555-Rev.). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86000693.

Technical specifications are defined for the production of demineralized water of the quality and quantity needed at the Barstow Solar Pilot Plant. Supplemental construction drawings of the water system are included. (BCS)

1408 OCEAN ENERGY SYSTEMS

REFER ALSO TO CITATION(S) 7102

1409 SOLAR THERMAL UTILIZATION

REFER ALSO TO CITATION(S) 7089, 7090, 7090, 7091, 7092, 7092, 7102, 7134, 7136, 7138, 7417, 7686

7113 **(BMFT-FB-T—85-083) Solar pilot test facility.** Hanitsch, R.; Bergmann, K.D.; Bruening, H.; Tekes, K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1985. 185p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE86750488.

In order to improve simulation programs for advanced solar systems it was necessary to carry out measurements on complete solar systems. Within the frame of an European research project data were taken from an identical system under different climatic conditions. In cooperation with the Institute of System Engineering (ISI; Karlsruhe) the simulation programs could be improved. Digital controllers and heat pumps were also investigated. For solar systems it is essential to calculate the size of the storage unit carefully and to do a precise insulation of the storage unit.

7114 (CONF-8202111—, pp 133-149) **Contribution made by wind energy to the energy balance of a combined solar/wind power plant.** Giess, B. 1982. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770042.

From Seminar on questions on application and strategies for the use of small wind power plants; Juelich, F.R. Germany (11 Feb 1982).

A combined solar/wind energy plant is being tested. This plant feeds the energy generated into the heating of a family house. Particular attention is paid to the contribution made by wind energy to the energy account, and the question to what extent the combined energy provided by sun and wind can adjust to the energy requirement of the house. First results of the measurements are indicated.

7115 **(EUR—8999) Lampedusa multi-stage-flash desalination plant adopting solar energy as primary energy source.** (Commission of the European Communities, Luxembourg). 1984. 63p. (In English and Italian). Commission of the European Communities, Luxembourg.

In the field of alternative energy supply sources, Agip Nucleare has built a desalination plant which uses a conventional proc-

esa, namely Multi-Stage Flash Distillation (MSF), fuelled by solar energy. The aim was to obtain operating and running data for the design of a small-capacity system capable of satisfying the drinking-water needs of small communities in isolated areas. The plant is located on the island of Lampedusa which receives a significant amount of solar radiation and is characterized by environmental conditions common to the areas which it is thought could utilize such plants. The project has been implemented by Agip S.p.A. with financial assistance from the EEC. Design and construction of the installation was performed by Jacocorossi, Rome, while the experimental work was carried out by CSEI of Bari. The programme was completed in the period from March 1980 to October 1981. The investigations performed indicated satisfactory performance of the MSF desalinator, but the maintenance demands were extremely heavy and the desalinator is now in a condition that makes its reuse completely uneconomic. The trials run on the solar unit, instead, indicate the excellent characteristics of this.

7116 **(EUR—9305) System for heating and for preparing clean hot water using solar panels without panel-screens cooled by heat-pumps.** Leysen, J.; Mayne, J.P. (Commission of the European Communities, Luxembourg). 1984. 1p. (In French). Commission of the European Communities, Luxembourg.

This report describes an installation for the heating and preparation of sanitary hot water of an administrative centre, using solar collectors without glazing cooled by a heat pump as well as the results obtained and the problems faced during an operation period of two years. The predeterminations have, in a general way, been confirmed by the measurements: - a solar system of this type gives much better performances than a traditional solar equipment for the heating of rooms and sanitary hot water; - the savings on consumption costs represent 25 to 30% and the primary energy savings 15 to 20% in comparison with a traditional central heating system, this in a new and properly insulated building. The following improvements will lead to better performances: - reduction of the consumption of electrical auxiliaries; - use of a less sophisticated regulation. The development prospects of such a system are related to: - the cost reduction of the equipment by means of a mass production and a better integration of the collectors into the building structure; - the information of fitters and architects on the existence of this product, its performance and the need to give it a triple function: insulation, imperviousness of the roofing and energy collecting.

7117 **(EUR—9774-EN) Long term solar heat storage through water tanks for the heating of housing.** Cucumo, M.; Marinelli, V.; Marinelli, V.; Oliveti, G.; Sabato, A. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 65p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

This is the final report concerning a research on solar plants fitted with buried water tanks for the interseasonal storage of solar heat. Computer codes for the design of such plants are described, as well as the design and the construction of a prototype solar plant built at Calabria University, having a reinforced concrete buried tank of 500 m^3, and a field of water heat pipe collectors of 95 m^2.

7118 **(EUR—9791-EN) Design study for a solar heated high school center located in northern Italy.** Hattem, D. van. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 90p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

The report gives a description of the design of a large solar heating system with a heat pump and a seasonal heat storage. The system is used for the heating of a high school center and is located in Northern Italy. The building is specially designed for this application and is also equiped with passive solar systems. A building description with illustrations is given. The collectors are simple flat plate collectors and the seasonal storage uses undisturbed earth as heat storage medium. A thermal and economic analysis is presented. Though the economics look not very good, it is estimated that further system optimization can improve this aspect.

7119 **(EUR—9911-FR/EN) Provincial domain of Chevetogne.** Gysel, M. van. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 84p. (In French and English). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

A solar heating system has heated the Olympic-size outdoor swimming pool of the domain of Chevetogne (Province de Namur, Belgium) since 1981. 2108 m^2 of single glazed, selective surface, copper absorber, solar collectors provide some 700 MWh per year in a season from April to September. A larger yield would result from using the heat generated in winter to heat nearby buildings. The system has been operated satisfactorily for three years until now. A grant of some BFR 11 million has been allotted in the framework of the demonstration programme "Solar heated swimming pools", carried out by the Commission of the European Communities. An extensive measurement campaign has allowed detailed appreciation of the operation.

7120 (Juel-Spez—297, pp 73-81) **Latent heat storage in a high performance passive solar heating system.** Brink, G.J. van den; Hensen, J.L.M. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

Calculations have been carried out on a high performance passive solar heating element with heat pipe energy transfer for different storage concepts. It is shown that the need for a store is strongly dependent on the system in which the element is integrated. The advantage of using a phase change material as storage medium instead of water is small for this application.

7121 (Juel-Spez—297, pp 82-86) **Passive solar component using rotating blades with latent heat storage so called 'rotating wall'.** Achard, P.; Mayer, D.; White, M.D. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

This component has been designed to permit collection storage and distribution of solar energy. It is a kind of green house effect wall that uses phase change materials (PCM) as storage medium. The system is composed of flat plat vertical or horizontal blades rotating on an axis behind a fixed glazing. The blades are for half composed of a container filled with PCM and for half of an insulating material.

7122 (Juel-Spez—297, pp 96-107) **Component efficiencies and system optimization.** Galen, E. van; Ouden, C. den. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

An original method is described that defines relations between component efficiencies and a dimensionless parameter that specifies the operating conditions of a particular system. The method is illustrated for an active solar space heating system. Weak points in the design for typical operating conditions become apparent. The method is a tool to judge the economic viability of single components.

7123 (Juel-Spez—297, pp 115-127) **Validation of a generalized storage model by means of dynamic testing. A final report to the SSTG Coordinator.** Marshall, R. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

Using a test procedure under development by members of the concerted action, Solar Storage Testing Group (SSTG), sponsored by the Commission of European Communities, a solar storage device is to be characterized by some six or more parameters using well defined, typically step response, tests. The question therefore

arises as to how well these parameters describe the arbitrary dynamic boundary conditions encountered in service. The approach taken by this author has been to define a generalized storage model, described elsewhere, and use the step response data to 'identify' two key parameters. The dynamic test then serves to confirm or refute the validity of the generalized model. Ultimately, however, it is the link with long term system performance, through the interaction between other parameters, and the storage parameters that is of interest. A design method known as the SEU Simplified Design Method has already been derived which establishes this link but for which experimental confirmation is lacking.

7124 (Juel-Spez—297, pp 147-158) **Practical application of latent heat stores.** Woodman, T.P. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

Some initial experiences with the application of commercial latent heat storage tubes in Switzerland are described. Planned or installed systems include solar passive storage (garden frame, Trombe wall) as well as active storage with solar heated air (attached greenhouse, storage wall in a house). Comments on heat transfer are included.

7125 (Juel-Spez—297, pp 184-196) **Design and simulation of a heat pump assisted space heating system with latent heat store.** Bostel, R.; Hesslinger, S.; Steiner, D.; Werner, R. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

In the framework of a current project the long time dynamic behaviour of a latent heat store in a heat pump assisted space heating system shall be investigated. The system draft is discussed and relevant parameters of storage design are given. Furthermore, computer simulation of the system is illustrated and first results obtained from computer runs are shown.

7126 (Juel-Spez—297, pp 212-215) **SOLVEIG project. Short-term heat storage in solar-heated building - a feasibility study of magnetite, water and salt hydrate heat stores.** Isakson, P.; Kellner, J. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

This report presents the results of a feasibility study and initial design of a full-scale experiment with a solar heating system incorporating short-term storage of heat in three alternative media: water, iron ore (magnetite) and salt hydrates. The main emphasis has been on systems incorporating latent heat storage in calcium chloride hexahydrate. Simulation studies of the thermal properties and behaviour of the systems have been carried out and some results are presented. The full-scale experiment which was planned has been postponed for the time being.

7127 (LA—10487-MS) **Vapor phase heat transport systems.** Hedstrom, J.C.; Neeper, D.A. (Los Alamos National Lab., NM (USA)). Sep 1985. Contract W-7405-ENG-36. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86004360.

This report describes progress in theoretical and experimental investigations of various forms of a vapor transport system for solar space heating, which could also be applied to service water heating. Refrigerant is evaporated in a solar collector, which may be located on the external wall or roof of a building. The vapor is condensed in a passively discharged thermal storage unit located within the building. The condensed liquid can be returned to the collector either by a motor-driven pump or by a completely passive self-pumping mechanism in which the vapor pressure lifts the liquid from the condenser to the collector. The theoretical investigation analyzes this self-pumping scheme. Experiments in solar test cells compare the operation of both passive and active forms of the vapor system with the operation of a passive water wall. The vapor system operates as expected, with potential advantages over other passive systems in design flexibility and energy yield.

7128 (NP—6770048) **Fundamentals and applications of passive solar systems.** Goretzki, P. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Bauoekonomie). Jul 1983. 74p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86770048.

The principles of solar energy use are presented, including the so-called 'greenhouse effect' which is the most important principle of solar energy use. The influencing parameters of solar radiation and the interactions between radiation and matter are discussed. Heat transfer, heat flow, thermal radiation and heat storage are presented. Passive systems, semipassive systems, and solar collectors using water as heat transfer fluid are discussed.

7129 (SERI/SP—271-2664, pp 251-259) **Comparison of predicted and reported performance for DOE-sponsored IPH field test experiments.** Lewandowski, A. (Solar Energy Research Institute, Golden, CO). Mar 1985. NTIS, PC A24/MF A01. File Number DE85002949. (CONF-8406111—).

From International Energy Agency workshop on the design and performance of large solar thermal collectors; San Diego, CA, USA (11 Jun 1984).

The Solar Energy Research Institute (SERI) has produced thermal performance predictions for seven of DOE's industrial process heat (IPH) field test experiments. These predictions were generated using SOLIPH, an hour-by-hour simulation code developed and maintained at SERI. The seven IPH sites were Caterpillar Tractor, San Leandro, CA; Dow Chemical, Dalton, GA; Home Laundry, Pasadena, CA; Lone Star Brewery, San Antonio, TX; Ore-Ida Foods, Ontario, OR; Southern Union Refining, Lovington, NM; and USS Chemicals, Haverhill, OH. Of these seven sites, all used parabolic trough collector fields. Four provided plant process energy from unfired steam boilers, one from a flash steam system, one steam or domestic hot water, and one preheated hot water. Input data for the model was obtained from contractor documentation, drawings, and site visits. The model configured for each of the seven sites and the data generated by the SOLIPH code are described. Comparisons between the predictions and reported data are also made. The differences between predictions and actual performance are highlighted along with a discussion of model limitations. Generally, it is felt that these SOLIPH results are the best available predictions for solar IPH systems to date and represent reasonable performance goals for well-maintained field hardware.

1410 SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 7089, 7114

7130 (DOE/CE/15088—T2) **Point focus parabolic solar collector.** Khorsand, H. (Khorsnad (Hossein), Eagle, ID (USA)). 29 Jan 1985. Contract FG01-82CE15088. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86003001.

The purpose of this project was to analyze and design a point focus parabolic collector. The analysis of a 15 meters diameter dish using finite elements computer programs shows high rigidity to weight ratio. A 15 meter dish weighs 7600 lb (excluding reflective surface), and when it is supported at three equally spaced support points, maximum deflection is .070 inch under a combined self, reflector, and receiver weight of 10,500 pounds. The dish subjected to wind loads at various elevation and azimuth angles showed good rigidity. Subsequently a detailed design of the dish followed. Most of the members of the structure are prefabricated in individual trusses to be assembled at the site. The structure for tracking also was analyzed. Design of tracking structure and foundation is not complete. A programmable electronic control system was designed for controlling the drive motors. The results of this project confirms the weight and cost saving which had been anticipated.

7131 **(EUR—9847-EN) Development of a selective solar absorber by control of surface microtopography.** Bannard, J. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 53p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

This project is concerned with the development of a pure-metal absorber, which would have the characteristic low I.R. emissivity, by defining and producing the appropriate surface microtopography. The work is divided into a number of parts: a) The development of a mathematical model to prove the theory of a pure-metal absorber and to define the parameters. b) To produce test specimens by a laser photo-fabrication technique to test the model, and c) to explore methods that would lead to a commercially-exploitable manufacturing process. The model has confirmed the theory that surface topography can alone act as a solar absorber: it has described reflectivities in the visible region as a function of the amplitude of the microasperities, angle of incidence, polarisation, profile shape, and metal characteristics for given values of peak-to-peak distance. The test specimens were manufactured with different peak distances in both gold and chromium, and with amplitudes determined by the exposure time during manufacture. These studies confirmed that high absorptivities in the visible region were possible and that a cut-off in absorptivity near to the ideal wavelength value (2-2.5 μm) could be obtained. In the electroplating work two approaches were studied.

7132 **(SAND—84-8929) Radiative transfer in a solar absorbing particle laden flow.** Houf, W.G.; Greif, R. (Sandia National Labs., Livermore, CA (USA); California Univ., Berkeley (USA). Dept. of Mechanical Engineering). Nov 1985. Contract AC04-76DR00789. 24p. (CONF-850810—31). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002840.

From National heat transfer conference; Denver, CO, USA (4 Aug 1985).

A possible receiver configuration is a cavity in which a falling sheet of solid particles is directly irradiated by the concentrated solar flux passing through the aperture. Regardless of the particular geometry, the radiative transfer within the falling particle curtain must be studied in order to determine the net radiative heating rate for the particles. A discrete ordinate radiative transfer model has been developed to predict the radiative coupling within the falling particle curtain. The model determines how much energy is absorbed by the particles, how much is transmitted to the rear wall of the receiver, and determines the effects of particle scattering and thermal emission on the net radiation absorbed by the particles. The model accounts for the directional nature of the radiation field, particle scattering, and the wavelength dependence of the optical properties. The discrete ordinate model has been used to assess the influence of the pertinent radiation transfer parameters in determining the local and overall particle heating rates. The results of this study are discussed as well as the analysis.

7133 **Flux concentrators in integrating sphere experiments: potential for increased detector signal.** Tardy, H.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Optics;* **24**: No. 22, 3914-3916(15 Nov 1985). Contract AC04-76DP00789.

Concentrators yield no increase in collected flux over bare detectors in integrating sphere applications where a large field of view is allowed but can provide meaningful increases in signal when the field of view must be limited. The correct concentrator to use is elliptical rather than parabolic. In calculations of sphere efficiency and correction factors, the detector—concentrator assembly should be treated as if it were the detector alone.

1420 HEAT STORAGE

REFER ALSO TO CITATION(S) 7120, 7123, 7124, 7125, 7126, 7317, 7322, 7409, 7410, 7411, 7412, 7413, 7415

7134 **(EUR—9852-EN) Earth as storage medium and heat source for heat pumps.** Fordsmand, M. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 46p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

A heating and cooling system with a 6 kW heat pump has been investigated with a solar collector and storage with vertical pipes in the ground. A solar collector of 14.4 m^3 seems to be a little underdimensioned. Eight vertical pipes of 14 m length have been adequate and a simple calculation method has been developed and tested with good results. A seasonal performance factor, SPF, of 3.6 has been achieved for a period of two heating seasons. The savings in primary energy are approximately 40% compared with traditional boilers. The good result is mainly achieved by an efficient construction of the heat pump itself.

7135 **(Juel-Spez—297, pp 24-38) Design considerations for latent heat stores.** Galen, E. van. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

Various latent heat storage technologies are discussed and pros and cons are explained. It is shown that the application of the store determines both technical and economic target specifications. Furthermore, it is demonstrated that test procedures and models for storage devices are necessary tools for further development and feasibility studies.

7136 **(Juel-Spez—297, pp 61-72) Overview of latent storage for passive solar applications.** Tomlinson, J.J. (Oak Ridge National Lab., TN (USA). Engineering Technology Div.). Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—). Contract AC05-84OR21400.

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

While state of the art passive solar systems can satisfy a portion of the space heating needs in many locations in the U.S., analyses of typical building heating requirements and available solar radiation indicates that the solar flux on a horizontal or south-facing vertical surface is sufficient to meet the entire building heating load during the winter. Since buildings consume approximately one-third of the primary energy budget, and space heating for these buildings is a major component, significant reductions in purchased energy requirements for buildings are possible through development and implementation of new, advanced, cost effective passive solar technologies. This paper provides an overview of passive solar storage techniques, available products and selected current research activities.

7137 **(Juel-Spez—297, pp 87-95) Experience in the JRC Ispra with latent heat storage for solar energy.** Pellegrini, G.; Coen-Porisini, F.; Reiter, F. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

The JRC activity on latent heat storage has concerned the characterization of commercially available latent heat storage components, their applicability in passive or hybrid solar systems and heat storage capacity measurements of salt mixtures. Recently, compatibility studies of commercial latent heat storage salt hydrates with some selected metals to be used for the containment were initiated.

7138 (Juel-Spez—297, pp 108-114) **Experimental and computer simulation results from a heat pump assisted solar heating system with latent heat storage.** Ziegenbein, B. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

Results from experimental investigations on heat pump assisted solar heating systems and extensive simulation studies lead to the conclusion that at present rates for electricity and fossil fuels thermal storage by latent heat of fusion is not economically competetive to sensible heat storage in water. Benefits to reasonal solar percentage of the annual energy demand or the COP of the heat pump are marginal.

7139 (Juel-Spez—297, pp 128-136) **60 kWh latent heat store contniner for heating purposes (for heating of buildings).** Friderichs, P. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

This report describes fundamental considerations which have led to the design of a latent heat store container. Some materials, suitable for thermal energy storage are compared. The construction and the testing results of a 60 kWh store on the basis of sodium orthophosphate dodecahydrate are presented.

15 GEOTHERMAL ENERGY

1501 RESOURCE STATUS AND ASSESSMENT

7140 **(DOE/ID/12079—125) GeoProducts WEN-2 well, Wendel-Amedee, California.** Sibbett, B.S. (Utah Univ. Research Inst., Salt Lake City (USA). Earth Sciences Lab.). 1985. Contract AC07-79ID12079. 21p. (ESL—152). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002010.

The GeoProducts WEN-2 well, drilled 2200 feet northwest of Wendel Hot Springs in Lassen County, California, penetrated 4330 feet (1320 meters) of Tertiary basalt flows and volcanoclastics. Production of 251°F (122°C) thermal fluids comes either from a fault or from intergranular permeability in a 570-foot thick quartzite conglomerate channel overlying the granitic basement rocks at a depth of 4900 feet. The chemistry, temperature and hydrostatic head of the resource in WEN-2 are very similar to that of WEN-1 to the northeast. Unknown faults in the granitic basement rocks, other than the Wendel fault, may be important channelways for the geothermal system. 4 refs., 3 figs.

7141 **(DOE/ID/12079—126) User Coupled Confirmation Drilling Program case study: City of Alamosa, Colorado, Alamosa No. 1 geothermal test well.** Zeisloft, J.; Sibbett, B.S. (Utah Univ. Research Inst., Salt Lake City (USA). Earth Sciences Lab.). Aug 1985. Contract AC07-79ID12079. 39p. (ESL—161). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86002012.

A 7118 ft (2170 m) deep geothermal test well was drilled on the south edge of the city of Alamosa, Colorado as part of the Department of Energy's User Coupled Confirmation Drilling Program. The project was selected on the bases of a potential direct heat geothermal resource within the Rio Grande rift graben and resource users in Alamosa. The well site was selected on the hypothesis of a buried horst along which deep thermal fluids might be rising. In addition, there were city wells that were anomalous in temperature and the location was convenient to potential application. The Alamosa No. 1 penetrated 2000 ft (610 m) of fine clastic rocks over 4000 ft (1219 m) of volcaniclastic rock resting on precambrian crystalline rock at a depth of 6370 ft (1942 m). Due to poor hole conditions, geophysical logs were not run. The stabilized bottom hole temperature was 223°F (106°C) with a gradient of 2.6°F/100 ft (47°C/km). Limited testing indicated a very low production capacity. 16 refs., 6 figs.

7142 **(LA-UR—85-3729) Geothermal activities in Central America.** Whetten, J.T.; Hanold, R.J. (Los Alamos National Lab., NM (USA)). 11 Sep 1985. Contract W-7405-ENG-36. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002444.

The Agency for International Development is funding a new program in energy and minerals for Central America. Geothermal energy is an important component. A country-wide geothermal assessment has started in Honduras, and other assessment activities are in progress or planned for Costa Rica, El Salvador, Guatemala, and Panama. Instrumentation for well logging has been provided to Costa Rica, and a self-contained logging truck will be made available for use throughout Central America. An important objective of this program is to involve the private sector in resource development. 4 refs., 3 figs.

1502 GEOLOGY AND HYDROLOGY OF GEOTHERMAL SYSTEMS

REFER ALSO TO CITATION(S) 7140, 7153

7143 **Sierra Nevada magmatic activity.** (Sandia National Laboratories). *Geothermal Energy Magazine;* **12**: No. 7, 14-15(Jul 1984).

This article reports on research aimed at understanding the magmatic system beneath the Sierra Nevada region and at evaluating the area as a site for deep drilling as part of the Continental Scientific Drilling Program. The research includes seismic studies to determine the position of the magma, precise and repeated measurement of gravity to detect evidence of magma movement, and chemical analysis of recently erupted samples of magma and of gases from fumaroles. The overlapping Mono Craters and Long Valley Caldera volcanic fields in the region have a history of violent eruptions. Recent seismic events, changes in surface elevation, and increased thermal emission in the region may indicate the movement of magma toward the surfaces. The scientists of the Sandia Laboratories are interested in the area because it provides the opportunity to explore a very hot region of the earth's crust.

1503 GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

7144 **(BMFT-FB-T—85-091) Development and construction of a temperature logging probe for deep wells.** Zoth, G.; Fesche, H.W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Niedersaechsisches Landesamt fuer Bodenforschung, Hannover (Germany, F.R.)). Aug 1985. 41p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE86750495.

In the Geological Survey of Lower Saxony in Hannover, a temperature probe which can be used to depths of about 8000 m was developed for hot dry rock experiments. The temperature can be as high as 260°C and the pressure 1300 bar. The accuracy of the probe is 0.12 K over the entire measuring range (0-260°C) and the sensitivity is +- 0.01 K. The accuracy is better by up to one order of magnitude within short ranges. The measuring device is computer controlled. An analog plotter is used for recording the data, which is also stored on magnetic tape for further use. Interpretation programs are available for representation of the data.

7145 **(EUR—8299) Distribution of electrical conductivity in the crust/upper mantle in the geothermal anomaly area of Tuscany.** Haak, J.; Schwarz, G. (Commission of the European Communities, Luxembourg). 1984. 1p. (In German). Commission of the European Communities, Luxembourg.

Magnetotelluric and geomagnetic depth-soundings have been carried out in the area of the strongest geothermal anomaly in continental Europe -the western part of Tuscany- in the years 1978 and 1979 to study the distribution of electrical conductivity in the crust and upper mantle. During the same time the crustal structure of Tuscany has been under study by seismic refraction measurements from a German-Italian Research Group. The aim of these projects was to develop a geothermal model of Tuscany.

7146 **(EUR—9324) Well SH2, general report (Monti Sabatini).** (Commission of the European Communities, Luxembourg). 1984. 48p. Commission of the European Communities, Luxembourg.

The geothermal exploration well SH2 is located in "Monti Sabatini" research lease, 2,5 km north of Vicarello (north shore of the Lago di Bracciano). The objectives of the well were to define the stratigraphic sequence and temperature trends at depth, to ascertain whether any fluids exist within permeable horizons in this geothermal area, and if so determine their physico-chemical characteristics. The drilling reached a total depth of 2499 m, where an extrapolated bottom hole temperature of 290°C was determined. The well appeared to be unproductive. Well SH2 provided contradictory evidence with regard to the existence of a geothermal field in the areas north of Bracciano Lake. For example, it confirmed the presence of an impermeable, flysch-type cover below the volcanites, the possible existence of a carbonate substratum at relatively shallow depth and, in particular, the existence of high temperatures and heat flow. On the other hand, it revealed a total lack of permeability, resulting from the thermal and metasomatic metamorphism affecting the terrains crossed by the well, and from the intense mineralization sealing the fractures. The intense nature of these phenomena suggests that they are probably not confined to the immediate vicinity of this well only, but spread over a much wider area.

7147 **(EUR—9333) Active audiomagnetotellurics, a method for the determination of the conductivity of the crustal structure - with model calculations and applications to the geothermal anomaly of Travale-Radicondoli (Tuscany).** Otten, J. (Commission of the European Communities, Luxembourg). 1984. 15p. (In German). Commission of the European Communities, Luxembourg.

The report deals with theory and practice of active audiomagnetotellurics. The following points are described: - a new field unit - model calculations for the magnetic fields - results and interpretation. The measuring unit consists of a receiving station and a transmitter at a distance of 2-10 km. Here 10 Amp. A.C. current with a frequency of between 0.01 and 2500 Hz is fed into the earth through a 300 m long dipole. The receiving unit registers the artificially-induced electromagnetic fields. The value and phase of electrical field-strength as well as the magnetic field density are measured, from which the specific resistance and its plans are calculated. The model calculations deal with the electric and magnetic field of an electrical dipole over a half-space with three layers. They are based on the theory of Sommerfield, that is transformed into relations that allow numerical calculation. The models were used for the interpretation of the measured data that were collected in the geothermal area of Travale-Radicondoli (Tuscany). The measurements were in agreement with the theory and with the findings of other authors.

7148 **(LA—10558-HDR) High-temperature borehole instrumentation.** Dennis, B.R.; Koczan, S.P.; Stephani, E.L. (Los Alamos National Lab., NM (USA)). Oct 1985. Contract W-7405-ENG-36. 49p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86004383.

A new method of extracting natural heat from the earth's crust was invented at the Los Alamos National Laboratory in 1970. It uses fluid pressures (hydraulic fracturing) to produce cracks that connect two boreholes drilled into hot rock formations of low initial permeability. Pressurized water is then circulated through this connected underground loop to extract heat from the rock and bring it to the surface. The creation of the fracture reservior began with drilling boreholes deep within the Precambrian basement rock at the Fenton Hill Test Site. Hydraulic fracturing, flow testing, and well-completion operations required unique wellbore measurements using downhole instrumentation systems that would survive the very high borehole temperatures, 320°C (610°F). These instruments were not available in the oil and gas industrial complex, so the Los Alamos National Laboratory initiated an intense program upgrading existing technology where applicable, subcontracting materials and equipment development to industrial manufactures, and using the Laboratory resource to develop the necessary downhole instruments to meet programmatic schedules. 60 refs., 11 figs.

7149 **(NEDO-OS—8406) Geothermal energy survey and technology. FY 1983 annual report.** (New Energy Development Organization, Tokyo (Japan)). 1984. 150p. NTIS (US Sales Only), PC A07/MF A01. File Number DE86900213.

This annual report on the activities of the New Energy Development Organization discusses progress in the following areas: (1) nationwide geothermal exploration survey; (2) verification and survey of geothermal resources prospecting techniques; (3) development of geothermal hot water power generating plant; (4) deep-seated geothermal water supply systems; and (5) international energy development cooperation. (ACR)

7150 **(NEDO-OS—8506) Geothermal energy survey and technology. FY 1984 annual report.** (New Energy Development Organization, Tokyo (Japan)). 1985. 162p. NTIS (US Sales Only), PC A08/MF A01. File Number DE86900214.

This annual report on the activities of the New Energy Development Organization discusses research progress in the following areas: (1) development of the binary cycle power generating plant; (2) HDR power generation system development; (3) development of deep geothermal hot water supply systems; (4) nationwide geothermal exploration survey project; and (5) confirmation study of the effectiveness of prospecting technology for deep geothermal resources. (ACR)

1508 GEOTHERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 7149, 7150

7151 **(EGG-M—22585) Heat Cycle Research Experimental Program, FY-1985.** Bliem, C.J.; Demuth, O.J.; Mines, G.L.; Whitbeck, J.F. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 7p. (CONF-8509142—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003219.

From Geothermal program review; Washington, DC, USA (11 Sep 1985).

The Heat Cycle Research Program, which is being conducted for the Department of Energy, has as its objective the development of the technology for effecting improved utilization of moderate temperature geothermal resources. Testing at the Heat cycle Research Facility located at the DOE Geothermal Test Facility, East Mesa, California is presently being conducted to meet this objective. Current testing involves a supercritical vaporization and counterflow in-tube condensing system. The paper presents a brief description of the test facility and a discussion of the test program. Results of the experiments for the supercritical heaters and the countercurrent, vertical, in-tube condenser are given for both pure and mixed-hydrocarbon working fluids. The heater and condenser behavior predicted by the Heat Transfer Research Institute computer codes used for correlation of the data was in excellent agreement with experimental results. Preliminary results of tests in which the turbine expansion "passed through the two-phase region" did not indicate efficiency degradation assignable to these metastable expansion processes. 6 refs., 9 figs.

7152 **Flash degasser for geothermal fluid.** (Lawrence Berkeley Laboratory). *Geothermal Energy Magazine;* **13**: No. 4, 18(Apr 1985).

This paper describes an improved degassing system that removes most of the noncondensable gases (CO_2, H_2S, N_2 and CH_4) that emerge from solution in geothermal fluid and interfere with powerplant operation. The pressure drop is lower than in earlier degassing systems and the heat loss is lower because brine and heat removed during the degassing step are returned to the process stream. The degasser operates in conjunction with a direct-contact binary-fluid heat exchanger that uses isobutane as the working fluid for the turbine. Operating parameters are calculated. The system increases energy-conversion efficiency for geothermal powerplants.

1509 GEOTHERMAL ENGINEERING

REFER ALSO TO CITATION(S) 7149, 7150

7153 **(DOE/SF/15799—T2) Geothermal research at the Puna facility. Technical progress report.** Chen, B. (Hawaii Univ., Honolulu (USA). Hawaii Natural Energy Inst.). 12 Dec 1985. Contract FG03-85SF15799. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004170.

Research progress is reported. A conceptual model of the reservoir was developed comprising two production zones of different characteristics: the upper zone producing liquid while the lower zone produces vapor. Preliminary studies were carried out at the HGP-A facility on the flocculation behavior of silica under various conditions. (ACR)

1510 DIRECT ENERGY UTILIZATION

7154 **(DOE/ET/27030—7) Direct utilization of geothermal energy for Pagosa Springs, Colorado. Final report, June 1979-June 1984.** Goering, S.W.; Garing, K.L.; Coury, G. (Coury and Associates, Lakewood, CO (USA)). Aug 1984. Contract FC07-79ET27030. 205p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86004136.

The Pagosa Springs Geothermal District Heating System was conceptualized, designed, and constructed between 1979 to 1984 under the US Department of Energy Program Opportunity Notice (PON) program to demonstrate the feasibility for utilizing moderate temperature geothermal resources for direct-use applications. The Pagosa Springs system successfully provides space heating to public buildings, school facilities, residences, and commercial establishments at costs significantly lower than costs of available conventional fuels. The Pagosa Springs project encompassed a full range of technical, institutional, and economic activities. Geothermal reservoir evaluations and testing were performed, and two productive ~140°F geothermal supply wells were successfully drilled and completed. Transmission and distribution system design, construction, startup, and operation were achieved with minimum difficulty. The geothermal system operation during the first two heating seasons has been fully reliable and well respected in the community. The project has proven that low to moderate-temperature waters can effectively meet required heating loads, even for harsh winter-mountain environments. The principal difficulty encountered has been institutional in nature and centers on the obtaining of the geothermal production well permits and the adjudicated water rights necessary to supply the geothermal hot water fluids for the full operating life of the system. 28 figs., 15 tabs.

17 WIND ENERGY

7155 **(CONF-8202111—) Questions of application and strategies for the use of small wind-power plants.** (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Energieforschung). 1982. 219p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770042.

From Seminar on questions on application and strategies for the use of small wind power plants; Juelich, F.R. Germany (11 Feb 1982).

The conference report contains printed copies of the lectures given within the framework of the seminar on 'Questions on application and strategies for the use of small wind power plants'. A separate summary of contents has been made for each of the 12 papers.

1703 REGULATIONS

7156 (CONF-8202111—, pp 33-55) **Brief presentation of the problem area of small-scale wind power plants (ET 4237 A).** Schmitz, D.; Tietze, A. 1982. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770042.

From Seminar on questions on application and strategies for the use of small wind power plants; Juelich, F.R. Germany (11 Feb 1982).

It is useful to separate two areas of application for the utilisation of wind energy into 'public energy supply' and 'private usage'. This paper deals with the latter area and attempts to answer the following questions: 1) What type of converter and what kind of storage should I use. 2) Will the construction of a wind power plant produce the desired success, and 3) what is the situation regarding the practice for granting permission for small-scale wind power plants. These are followed by the formulation of theses on the question complexes raised, which circumscribe the present state of development and the tasks for future development resulting from it.

1704 ECONOMICS

REFER ALSO TO CITATION(S) 7156

1705 ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 7156

1706 WIND ENERGY ENGINEERING

REFER ALSO TO CITATION(S) 7102, 7114

7157 **(BMFT-FB-T—85-092) Field test of an autonomous wind-diesel power plant.** Fritzsche, A.; Knoebel, U.; Ruckert, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Dornier-System G.m.b.H., Friedrichshafen (Germany, F.R.)). Sep 1985. 138p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE86750491.

The integration of a wind converter system and a diesel generator increases the reliability of such an autonomous power plant. The priority of wind energy utilization, this means also stand-alone operation of the wind turbine, is required for optimum fuel saving. The aim of the project was the check of the developed hybrid power plant and an estimation of economics, both being a base for the preparation of the production stage. The field tests were performed at the DFVLR test area (Schnittlingen, FRG). Predominantly the dynamic behaviour of the wind turbine (12 kVA) and of the diesel generator (25 kVA), operated by a central control unit, were tested with simulated 24 h load profiles. Today economic system operation requires still a large contribution of wind energy. The market situation will be improved considerably by decreasing investment costs for the wind turbine.

7158 (CONF-8202111—, pp 57-75) **Experimental area for wind-driven power plants in Pellworm.** Fries, S. 1982. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770042.

From Seminar on questions on application and strategies for the use of small wind power plants; Juelich, F.R. Germany (11 Feb 1982).

In order to permit examination and comparison of the reliability and performance of small-scale wind power plants, a test area was provided on the island of Pellworm. It was intended that the 10 kW windpower installations available on the German market should be subjected to two years of long term trials in the experimental area, which was put into operation in 1980. It was not long before it was recognised that the programme as originally envisaged was not capable of being put into practice. Almost all the selected wind power plants were inadequately developed for the requirements necessary for consistent measuring operations. The paper gives a general view of the plants tested and the results of the measurements. Attention is given to the continuation of the Pellworm project.

7159 (CONF-8202111—, pp 77-98) **Possible applications for small-scale wind energy plants and the requirements resulting from them.** Jenke, T. 1982. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770042.

From Seminar on questions on application and strategies for the use of small wind power plants; Juelich, F.R. Germany (11 Feb 1982).

Alongside nuclear and solar energy, regenerating energy sources will become one of the main pillars of world-wide energy demand. This paper names the advantages and snags of using wind energy and lists various possible applications of wind energy. Then, the technical requirements inherent in the system are formulated. The paper presents possible applications in the form of some examples for which the technology is already available, such as a parallel network, an island system and two variations of operation with a safeguarded line. It is considered that an essential support in favour of the use of wind energy will be putting into practice as many different types of application as possible.

7160 (CONF-8202111—, pp 99-114) **Development and testing of heat-generating wind energy plants for heating buildings.** Witt, H. 1982. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770042.

From Seminar on questions on application and strategies for the use of small wind power plants; Juelich, F.R. Germany (11 Feb 1982).

Intermediate report on the developments which have been going on since the end of 1979 on heat-generating wind energy plants for heating buildings. The aim of the project is to determine whether it is economically and technically feasible to use wind energy for the direct heating of individual homes, farms, market gardens etc. Energy transformation takes place by means of a water whirl brake. The report focuses on the following points: 1) development of the water whirl brake, 2) development of a suitable wind energy drive unit, 3) constructing a plant for long-term trials, 4) construction of a control system, 5) long-term trials, results, evaluation with particular consideration of the cost/benefit analysis. The first three points have been concluded. Of particular interest were the results of development work on the water-whirl brake. It can be considered certain that small, easily-manufactured units can be constructed with sufficiently high specific output as to be suitable for direct drive without gearing in direct combination with high-speed runners.

7161 (CONF-8202111—, pp 115-132) **DFVLR MODA-10 WEK.** Molly, H.P. 1982. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770042.

From Seminar on questions on application and strategies for the use of small wind power plants; Juelich, F.R. Germany (11 Feb 1982).

This report explains the working of the regulator developed by DFVLR, which uses the aerodynamic moment occurring on the rotor blade as an adjusting factor and force. Initial measurements on MODA 10 show the working of this regulator in operation. Then, some suggestions are put forward as to where DFVLR sees the focus of research and development in this field on the basis of its experience of operation.

7162 (CONF-8202111—, pp 151-161) **Measuring tests on a 15 KW wind power plant (ET 4063).** Machens, U. 1982. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770042.

From Seminar on questions on application and strategies for the use of small wind power plants; Juelich, F.R. Germany (11 Feb 1982).

The project was concluded in September 1981 after running for a period of 4 1/2 years. This talk will only take up one aspect of the very comprehensive results. The influence of the mean times in measuring a wind power plant. Two contexts are essential for the advance calculation of the energy supplied by a wind power plant in a particular location: 1) The frequency distribution of wind speeds on the selected site and 2) The performance characteristics of the type of wind power plant in question. The amount of energy produced by the plant within a specified period can be determined as the product of these two curves.

7163 (CONF-8202111—, pp 163-176) **Construction and testing of a wind park on the Cyclad Island of Kythnos.** Koeppel, W. 1982. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770042.

From Seminar on questions on application and strategies for the use of small wind power plants; Juelich, F.R. Germany (11 Feb 1982).

The concept of a wind park on the Cyclad Island of Kythnos consists of several identical Type AEROMAN wind converters installed parallel to one another. One special focal point lies in the development of the electrical interlinking devices for the individual plants among themselves and interference-free linking to the existing small island network. The aim of the project is to become familiar with the problems raised by operating such a wind park during an 18-month field study. Attention is paid to the selection of a site, the wind conditions, the place of erection, the amount of energy supplied and the level the work has reached.

7164 (CONF-8202111—, pp 177-197) **Design concept of the 20 kW Darrieus plant in Argentina.** Fritzsche, A.; Lippmann, G. 1982. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770042.

From Seminar on questions on application and strategies for the use of small wind power plants; Juelich, F.R. Germany (11 Feb 1982).

Dornier System has been working on the development of wind energy plants with vertical rotor axis according to the Darrieus principle since 1974. This line of development is being continued in a German-Argentine project to develop, build and test a 20 kW plant. On the German side, it is intended that experience should be acquired with the plant, which will include the aerodynamic and structural dynamic behaviour and also the function of processing electric energy. The paper deals with the demands on the site chosen, the overall concept of the plant, the erection and testing of the plant and the next steps in development.

7165 (CONF-8202111—, pp 199-204) **Construction of two AEROMAN 11/11 wind energy converters for Indonesia.** Thiele, H.M. 1982. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770042.

From Seminar on questions on application and strategies for the use of small wind power plants; Juelich, F.R. Germany (11 Feb 1982).

The construction of 2 AEROMAN 11/11 wind energy converters is intended to give Indonesia a relatively fast start in the development of modern wind power plants. A German-Indonesian project plans, among other things, the following activities: dimensioning the concept so as to fit the operation of an ice production plant, construction and delivery of an AEROMAN plant including an ice-production plant with all the necessary equipment, delivery of a second AEROMAN plant for training purposes, instruction for 2 Indonesian engineers in the handling and operation of AEROMAN installations and the recording of wind data on the Indonesian site.

7166 (CONF-8202111—, pp 205-220) **New paths for wind energy.** Wortmann, F.X. 1982. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770042.

From Seminar on questions on application and strategies for the use of small wind power plants; Juelich, F.R. Germany (11 Feb 1982).

In the past, it was repeatedly attempted to design wind energy plants as rigidly and firmly as possible. Nowadays it is considered certain that this will not lead to a solution of the technical problems, of wind energy plants not to mention the economic ones. The author gives reasons why the asymmetrical single-blade rotor is probably the only design - provided a suitable uncoupling of rotor and tower is acheived - which can lead to a satisfactory solution in both the technical and economic aspects.

7167 (DOE/ET/20372—T1) **Innovative wind turbines. The circulation control vertical axis wind turbine. Final report, May 1, 1978-December 31, 1979.** Walters, R.E.; Migliore, P.G.; Wolfe, W.P. (West Virginia Univ., Morgantown (USA). Dept. of Aerospace Engineering). Jan 1980. Contract AC05-76ET20372. 96p. (ORO—5135-80/1). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86002176.

An indoor facility was developed for use in the aerodynamic testing of Darrieus wind turbine blades. A three-component internal strain gage balance was used to deduce lift, drag and moment coef-

ficients of blades whose angle of attack, chord to radius ratio and Reynolds number can be systematically varied. The unusual flow field of this test environment necessitates unique downwash corrections for angle of attack and induced drag.

7168 **(DOE/R0/00608—T1) Student installed Hooper Bay wind generator produces 9990 kWh in six months.** (Fairbanks Grant, Hooper Bay, AK (USA)). [1986]. Contract FG06-80R000608. 13p. NTIS, PC A02. File Number DE86000448.

A 10-kw Jacobs wind power generator was installed and became operational March 27, 1982. On October 26, after generating 12,750 kWh, the governor failed, causing the wooden blades to splinter. Steps taken to put the generator back into service are discussed. (DLC)

7169 **(DOE/R9/50006—T1) [Aramas Kapw appropriate energy demonstration site.] Final report.** (Micronesia Bound, Inc., Nett Point, Aramas Kapw, HI (USA)). 1982. Contract FG03-80R950006. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000347.

The Nett Point, Aramas Kapw Base Camp was used as a project to demonstrate the use of sun, wind, and water for energy. The project was to result in two wind-powered electrical systems supplemented with a solar cell array to provide power for lighting, radio communication, navigational beacon, refrigeration, etc. Young people were trained. Two workshops were held, on hydro power and solar energy. (DLC)

7170 **(EPRI-AP—4335) Rotationally sampled wind and MOD-2 wind turbine response. Final report.** Connell, J.R.; George, R.L.; Morris, V.R.; Sandborn, V.A. (Pacific Northwest Labs., Richland, WA (USA)). Nov 1985. Contract AC06-76RL01830. 131p. NTIS, PC A07/MF A01; 1 - Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. File Number DE86003367.

In an effort to learn more about how wind behaves hear wind turbines, researchers rotationally sampled winds by attaching sensors to the blades of a MOD-2 wind turbine. This fieldwork demonstrates the feasibility of a blade-mounted measuring technique and provides new data on the winds encountered by a rotating turbine blade.

20 ELECTRIC POWER ENGINEERING

7171 **(DOE/RA/50658—T1) Leader-follower strategies under modeling and information uncertainties. Final technical report.** (Dynamic Systems, Urbana, IL (USA)). Sep 1985. Contract AC01-81RA50658. 260p. NTIS, PC A12/MF A01; GPO Dep. File Number DE86000203.

Focus of the research is the characterization and formulation of control strategies for large-scale systems which have two or more decision making authorities. The actions of each decision maker contribute to the total behavior of the system. Furthermore, the information on which each decision maker is based is affected by the action of the other decision makers. Thus the role of multiple decision making in the theory and methodology pertaining to the analysis, planning, and control of large-scale systems is very significant. This research addressed the central influence of hierarchical organizational forms in developing control strategies in large-scale systems when the decision makers do not have identical capabilities, priorities, and information structures. This report is divided into five parts corresponding to the five tasks for the project: global feedback, adaptive control concepts, multiparameter singularly perturbed systems with multiple decision makers, multitime scales induced by the information pattern, and problems of control organizations where the organizational center is the leader and the agents are followers. (DLC)

7172 **(EPRI-EL—4202) Electromagnetic Transients Program (EMTP) primer. Final report.** Mauser, S.F.; McDermott, T.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Power System Engineering Dept.). Sep 1985. 265p. NTIS, PC A12/MF A01; 1 - Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. File Number DE86000060.

This document is an outgrowth of a survey and analysis of Electromagnetic Transients Program (EMTP) user needs, in which improved user's documentation was determined to by the single most important enhancement to the EMTP. The Primer is an EMTP training manual for new users. It includes introductory material and eleven sample studies so that the reader can learn by the case study method. The Primer is part of a series of new EMTP user manuals which covers program operation, theory, and application guide lines.

2001 POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 6941, 7157, 7315, 7355

7173 **(EPRI-CS—4252-Vol.1) Dissimilar-weld failure analysis and development program. Volume 1. Executive summary. Final report.** (Metal Properties Council, Inc., New York (USA)). Nov 1985. 60p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920064.

Failure of dissimilar metal welds is a major cause of forced outage in fossil boilers. A research project was carried out to: Develop a clearer understanding of the underlying causes of dissimilar weld failures; develop a methodology for estimating the residual life of service welds; develop a critical discriminatory test to predict the relative performance of welds; and develop guidelines for improved-performance dissimilar welds. The research methodology included review of prior experience as well as evaluation of a large number of failed and unfailed welds obtained from boiler superheaters or reheaters. The evaluations included metallography, mechanical testing and boiler inspections; in many cases, tube loading histories at the dissimilar weld locations were estimated. This work resulted in a clearer understanding of the root cause of weld failures. Furthermore, a quantitative relationship was derived between failure susceptibility and weld metal "system" loads, cycles, and temperatures (all critical parameters in weld performance). Accelerated discriminatory tests, including a number of geometries and modes of stressing and thermal cycling, were examined. The shortest time to failure, good reproducibility, and the capability to control loads and monitor cracking were achieved in a test which involved applying four-point bending loads to internally pressurized full-size tubular specimens. Tests at 593°C (1100°F), which involved temperature cycling, had failure times of only 400 h for stainless-steel fillers and 1500 h for nickel-base fillers. Guidelines for improved welds were derived from all the program results. They include and offer guidance on the considerations of weld-filler selection, weld geometry, heat treatment, etc., in relation to expected service conditions and on locating DMWs to optimize service performance. 7 refs., 18 figs., 3 tabs.

7174 **(EPRI-CS—4252-Vol.4) Dissimilar-Weld Failure Analysis and Development Program. Volume 4: utility plant results. Final report.** Holko, K.H.; Li, C.C.; Ryder, R.H.; Roberts, D.I.; Dahms, C.F. (Metal Properties Council, Inc., New York (USA)). Nov 1985. 421p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920066.

A major part of the program activities on research project RP1874 involved the examination of dissimilar metal welds (DMWs) after service in utility power-plant boilers. The welds examined included DMWs made with both stainless-steel and nickel-based filler metals having service lives ranging from about 40,000 to 170,000 hr. This examination included a detailed inspection of superheater and reheater assemblies and a review of plant operating records. A variety of analytical methods was used to assess the level of damage in the DMWs and to correlate the observed damage with plant operating conditions. For three units, a very detailed study was performed of damage levels and the history of the system stresses to which the welds had been subjected. Analytical models and residual life prediction methods were developed from this study. More limited analyses were performed on DMWs from five other units, the metallurgical analyses only were performed on selected DMWs from another 13 units. These data were used to confirm results from the detailed analyses. It was found that several microscopically different modes of failure can occur in service.

They may occur separately or together, but are creep dominated. It was also found that the principle factors governing failure are the service conditions of temperature, temperature cycling, and system loads. In general, nickel-based filler-metal DMWs outperform the stainless-steel filler-metal DMWs under the same conditions. Gross carbon depletion of the low-alloy-steel heat-affected zone (HAZ) was never observed in the service samples, although carbon migration into the weld metal was always evident. Based on the results of the plant analyses, together with the data from laboratory tests, a preliminary analytical method was developed for assessing the remaining life of stainless-steel filler-metal DMWs.

7175 **(EPRI-CS—4252-Vol.5) Dissimilar-Weld Failure Analysis and Development Program. Volume 5: evaluation of acoustic emission and enhanced radiography. Final report.** Roberts, D.I.; Grunloh, H.J.; Holko, K.H. (Metal Properties Council, Inc., New York (USA)). Nov 1985. 37p. Research Reports Center, Box 50490, Palo Alto, Ca 94303. File Number TI86920067.

A preliminary evaluation was made of the potential of acoustic emission and enhanced radiographic techniques for detection of damage in typical boiler tubing dissimilar metal welds removed from service. Results showed that enhancement of existing radiographic techniques did not significantly improve sensitivity. However, the work confirmed that the basic radiographic technique is useful and valuable. The results of the acoustic emission studies showed it to have considerable promise for development into a more rapid and perhaps more sensitive in situ damage assessment tool. Further development work is recommended. 2 refs., 15 figs., 4 tabs.

7176 **(EPRI-EL—4333) Methodology for predicting torsional fatigue life of turbine generator shafts using crack initiation plus propagation. Final report.** Anderson, A.F.; Williams, R.A.; Wilkening, W.W.; LeFort, P.N. (General Electric Co., Schenectady, NY (USA). Steam Turbine-Generator Engineering and Manufacturing Dept.). Nov 1985. 105p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920060.

An overall methodology now exists that addresses both crack initiation and propagation in predicting the fatigue life of large turbine generator shafts. It can estimate previous torsional transient damage and predict residual life. In short, this improved methodology allows utilities to determine the availability of turbogenerators with greater confidence.

7177 (Juel-Spez—297, pp 271-288) **Heat storage for power stations in the temperature range 200°C to 500°C.** Stiner, D. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

Results of a survey study are presented on current technology related to thermal energy storage in the temperature range from 200°C to 500°C. Thermal characteristics of latent heat storage and high temperature water storage are discussed. Their basic cost structure is shown; sensible storage in thermal oil is also included. Thermodynamic aspects of storage integration are discussed and the apparent techno-economical problems of storage application for large power plants are outlined.

7178 **(NP—6770045) Nonlinear control of a H_2/O_2-steam reactor.** Wolfmueller, K. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Elektrotechnik). 11 Jul 1984. 124p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE86770045.

The process of a fast steam generation via the combustion of H_2 and O_2 is investigated with respect to dynamic and control aspects. A nonlinear dynamic model is presented. The reduction of the order of the system for a controller synthesis is reached by structural assignment and suitable determination of the model parameters. A nonlinear decoupling method is described and a controller design is performed with respect to measured disturbances. The aims of the method are verified by means of numerical simulations. The problems of realization are considered. Finally, the specifications of the control system and the design method are verified by experimental results with the test rig.

7179 **Properties of ultra-clean coal-water slurry fuels for direct-fired gas turbines.** Smit, F.J.; Anast, K.R.; Bhasin, A.K. (AMAX Extractive Research & Development, Inc., Golden, Colorado). *American Society of Mechanical Engineers, [Paper]*; No. 84-JPGC-GT-5, 10(Sep 1984). (CONF-840905—).

From Joint power generation conference; Toronto, Canada (30 Sep 1984).

Under contract DE-AC21-83MC20700 from the Morgantown Energy Technology Center (METC), AMAX Extractive R & D prepared two 250-gallon lots of clean and ultra-clean coal-water slurry fuel for use in a U.S. Department of Energy program to develop coal-fueled direct-fired gas turbines for power generation. Both lots were prepared from Eastern Kentucky high volatile bituminous coal ground to pass 44 micrometers. The first lot, containing 1.95 percent ash, was prepared from coal cleaned by standard industry physical separations. Advanced chemical coal cleaning technology was used during preparation of the second lot which contained 0.40 percent ash. The grinding and cleaning operations and the rheology, composition and other properties of the two slurry fuels are described.

7180 **(DOE-tr—273-Vol.6, pp 6L12.1-6L12.10) Liquid metal magnetohydrodynamic system for utilization of low grade heat.** Branover, H.; El Boher, A.; Smith, I.; Sukoriansky, S.; Yakhot, A. (Ben Gurion University of the Negev, Beer Sheva). 1983. Translation source information not available . NTIS, PC A16. File Number DE85018282.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth International Conference on MHD Electrical Power Generation. Vol. 6.

A low temperature, liquid metal magnetohydrodynamic (MGD) pilot plant with an electrical output of 5 to 10 megawatts was designed jointly by Ben Gurion University and Argonne National Laboratory. It will be built at Ben Gurion University (BGU) by the end of 1983. The paper presents two versions of the design. One is a NaK-Neohexane system, the other a mercury refrigerant 113 system. 6 refs., 12 figs., 2 tabs.

7181 **(DOE-tr—273-Vol.6, pp 6B16.1-6B16.8) Definition of a development program for an advanced magnetohydrodynamic power train: results from task one.** Muller, D.J.; Clark, J.P.; Hals, F.A.; Primo, A.C.; Shah, R.P. (General Electric Company, Advanced Energy Programs Department, Schenectady, NY; Combustion Engineering Inc., C-E Power Systems, Windsor, Connecticut; AVCO Everett Research Laboratory, Inc., Everett, Massachusetts; Charles T. Main, Inc., Thermal Power Division, Boston Massachusetts; General Electric Company, Corporate Research and Development Center, Schenectady, NY). 1983. Translation source information not available . NTIS, PC A16. File Number DE85018282.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth International Conference on MHD Electrical Power Generation. Vol. 6.

Task one of the program described in the title included an analysis of performance requirements and design criteria of combined magnetohydrodynamic (MGD) and steam power plants. A systematic analysis of three magnetohydrodynamic steam power plants has been performed: a 1,000 MWe large scale plant; a 500 MWe full scale commercial plant and a 200 MWe commercial prototype plant. Each of these plants has been analyzed for utility acceptability and early commercialization. This analysis has been directed toward achieving minimum costs, maximum utilization of off the shelf and state of the art equipment and minimum development time to provide early commercial availability. The study includes realistic and systematic analysis of the performance and economics of these plants. Component arragnements and operating conditions have been optimized for each of the power levels noted. Also, the plant studies have been performed to derive power train component performance requirements. The work described in this report was performed under United States Department of Energy (DOE) and National Aeronautics and Space Administration (NASA). The National Aeronautics and Space Administration Manager for Task one

effort was Mr. R.J. Sovie. The analysis was done by the Advanced Energy Programs Department of the General Electric Company with the support of a team of subcontractors. Major contributors to this effort are listed in a table. 2 refs., 1 fig., 7 tabs.

7182 **(DOE-tr—273-Vol.6, pp 6A14.1-6A14.16) Technical status of magnetohydrodynamics (MGD) in the United States: an overview.** Hardgrove, J.A.; Jackson, W.D. (Symposia for the Engineering Aspects of Magnetohydrodynamics, Inc. (SEAM), Washington, DC). 1983. Translation source information not available . NTIS, PC A16. File Number DE85018282.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth International Conference on MHD Electrical Power Generation. Vol. 6.

The major technical accomplishments in the United States are presented and technical advances reported at the Twenty First Symposium on the Engineering Aspects of Magnetohydrodynamics are reviewed. Perspectives on the development status of magnetohydrodynamics and roles of the main participants, including a private sector scenario for commercialization, are also discussed. 26 refs., 2 figs.

2002 ENVIRONMENTAL CONTROL TECHNOLOGY

REFER ALSO TO CITATION(S) 7179, 7233, 7403, 7828, 7829

7183 (CONF-8406161—, pp 116-126) **Westinghouse advanced combined NO/sub x//SO_2 removal system.** Kanter, I.E. (Westinghouse Research and Development Center, Pittsburgh, PA). 1984. NTIS, PC A14/MF A01. File Number DE85017478.

From DOE contractor review meeting for flue gas cleanup; Pittsburgh, PA, USA (12 Jun 1984).

Research and development work involved in the simultaneous removal of NO/sub x/ and SO_2 from fossil-fueled combustion stacks is discussed. Specifically, the development of a process for post combustion emissions control technology based on a novel electric discharge driven reactor system which can be retrofitted into existent power plant systems is described. The major thrust of the program is to prove engineering feasibility of the process when applied to coal combustion flue gas such as is found in electric utilities' power plants. The goal is the development of an economic emissions control system capable of removing 90% of NO/sub x/ and SO_2.

2003 POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 7793

7184 **(EPRI/EL/EM—4290-Vol.1) Harmonics and electrical noise in distribution systems. Volume 1. Measurements and analyses. Final report.** Vincent, W.R. (SRI International, Menlo Park, CA (USA)). Oct 1985. 169p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920048.

Characterization of the harmonics and electrical noise on distribution lines at 10 utilities showed that discrete harmonics of the power frequency are the noise most likely to impair distribution line carrier system performance. Sources of these harmonics are customer switching devices and nonlinear loads. The report describes mitigation methods for utilities and equipment manufacturers.

7185 **Operational characteristics of a 1000 MVA superconducting power transmission system.** Thomas, R.A. (Brookhaven National Laboratory, Associated Universities Inc., Upton, NY). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **MAG 21:** No. 2, 795-798(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

Over the last three years, the power transmission project at Brookhaven National Laboratory has been testing two flexible superconducting cables for the transmission of ac electric power. These cables are each 115 m long and are rated at 80 kV, 4100 A singlephase for a power rating of 333 MVA - (1000 MVA, 138 kV, 3 phase). They have been operated over the range of 7-12 K in supercritical helium at 14-15 atm. The cables have been tested at currents and voltages above their ratings and have also been operated with no coolant flow to study the effects of loss of refrigeration on cable performance. The insights gained from the operating of the system over this extended period will be presented. Finally, we will delineate those areas which will require further research before this technology can be integrated into the U.S. electrical power delivery system.

7186 **Construction of MIT-DOE 10-MVA superconducting generator.** Smith, J.L.; Liepert, A.G. (Massachusetts Institute of Technology, Cambridge, MA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **MAG 21:** No. 2, 791-794(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

A 10-MVA synchronous alternator has been designed and constructed to demonstrate advanced concepts for power station generators with superconducting field windings in the rotor. The experimental generator is in the final stages of assembly in preparation for no load tests and a 30-day full load test. This paper describes the construction of the generator, including the details of the superconducting rotor with emphasis on the unusual features. Problems in fabrication and assembly are discussed.

7187 **(CE-Trans—7554) Development of the French 400 kV system up to the end of the century.** Persoz, H. Translated from *RGE, Revue Generale de l'Electricite ;* **88:** No. 6, 463-470(Jun 1979). 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85902141.

At present it is generally accepted that a voltage above 400 kV will not arrive in France until the end of the century, if not later. The 400 kV system must therefore be suitably organized to enable it to reliably fulfill the functions of a large interregional power transfer system and a distribution system. This will be achieved by fairly dense meshing of the 400 kV system covering the entire country. This will entail the progressive absorption of the 225 kV system, in favor of an extension of direct 400 kV/HV conversion (HV in France is either 90 kV or 63 kV). A number of technical problems are examined in this paper: choice of cross-section for the conductors, reactive compensation on the system, short-circuit problems, questions of space and system operation. An account is then given of the methods employed at EDF for planning this system for the end of the century, i.e., for establishing its volume and location.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 7259, 7280

7188 **(DOE/NBM—5017971) Technical description of the heterogeneous gas core reactor.** Diaz, N.J.; Dugan, E.T.; Han, K.I. (Florida Univ., Gainesville (USA). Dept. of Nuclear Engineering Sciences). [1986]. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85017971.

Solid-fueled and liquid-fueled heterogeneous nuclear reactors have already undergone extensive analysis and development. Gas-fueled nuclear reactor studies, however, have been restricted to either (1) homogeneous core systems, (2) two large separate regions of fuel and moderator; and (3) concentric rings of fuel-moderator arrangements. The gas-fueled heterogeneous core reactors consist of an array of coolant/moderator channels in a vessel containing a fissionable gas or a mixture of fissionable and non-fissionable gases. The moderator/coolant is, therefore, distributed in the core but physically separated from the gas. It is this moderator/coolant distribution in a variable lattice arrangement surrounded by the gas which constitutes the bases of this concept. The results of this arrangement on the neutron and fuel economy, power distribution,

power density, and heat transfer characteristics have been found to be extremely advantageous. 13 figs.

7189 **(UCID—20015) Fission power: a search for a "second-generation" reactor.** Hovingh, J. (Lawrence Livermore National Lab., CA (USA)). 8 Jul 1985. Contract W-7405-ENG-48. 112p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85017142.

This report touches on the history of US fission reactors and explores the current technical status of such reactors around the world, including experimental reactors. Its purpose is to identify, evaluate, and rank the most promising concepts among existing reactors, proposed but unadopted designs, and what can be described as "new" concepts. Also discussed are such related concerns as utility requirements and design considerations. The report concludes with some recommendations for possible future LLNL involvement.

2101 POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 7009, 7225, 7249, 7253, 7254, 7261, 7264, 7265, 7267, 7268, 7269, 7272, 7277, 7279, 7282, 7284, 7293, 7295, 7299, 7300, 7301, 7309, 7310

7190 **(EGG-EA—6906) Conformance to Generic Letter 83-28 Items 3.1.3 and 3.2.3, Big Rock Point Plant.** VanderBeek, R.; Haroldsen, R.O. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1985. Contract AC07-76ID01570. 9p. NTIS, PC A02/MF A01 - GPO. File Number TI86003211.

This EG and G Idaho, Inc. report provides a review of the submittals from the Big Rock Point Plant for conformance to Generic Letter 83-28, items 3.1.3 and 3.2.3.

7191 **(NUREG/CR—2000-Vol.4-No.10) Licensee Event Report (LER) compilation for month of October 1985. Volume 4, No. 10.** (Oak Ridge National Lab., TN (USA)). Nov 1985. Contract AC05-84OR21400. 119p. (ORNL/NSIC—200-Vol.4-No.10). NTIS, PC A06/MF A01 - GPO. File Number TI86003825.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the month of October 1985.

7192 **(PNL-SA—13035) Current capabilities for continuous AE monitoring to detect flaws in reactor pressure boundaries.** Hutton, P.H.; Kurtz, R.J. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 17p. (CONF-850670—27). NTIS, PC A02/MF A01 - GPO. File Number TI85018526.

From ASME Pressure Vessel and Piping Division conference; New Orleans, LA, USA (24 Jun 1985).

A major program at Pacific Northwest Laboratory (PNL) is directed to developing the use of acoustic emission (AE) methods for continuous surveillance to detect and evaluate flaw growth in reactor pressure boundaries. The work is supported by the US Nuclear Regulatory Commission, Division of Engineering Technology. In the first phase of the program, test data from laboratory specimens was used to develop preliminary relationships for identification of crack growth AE and for estimating flaw severity from AE data. Two subsequent phases concern evaluation and refinement of the AE technology through monitoring a long term fatigue test of a heavy section vessel called the ZB-1 vessel (Phase 2) and demonstration of AE surveillance on Watts Bar Unit 1 Reactor (Phase 3). 6 refs., 9 figs.

7193 **(PNL-SA—13082A) Long-lived activation products in reactor materials.** Evans, J.C. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1985. Contract AC06-76RL01830. 3p. (CONF-850720—3). NTIS, PC A02/MF A01 - GPO; GPO Dep. File Number TI85016270.

From International nuclear reactor decommissioning planning conference; Bethesda, MD, USA (16 Jul 1985).

This report concerns the problems posed to light water reactor (LWR) decommissioning by long-lived activation products produced in the major construction materials of the reactor were assessed under a three-phase project. Reactor components investigated include the bioshield, pressure vessel, vessel cladding, and stainless steel internals.

7194 **(PNL-SA—13489) Development and validation of a real-time SAFT-UT system for inservice inspection of LWRs.** Doctor, S.R.; Reid, L.D.; Hall, T.E.; Littlefield, R.J.; Gilbert, R.W.; Crawford, S.L.; Baldwin, A.J.; Bowey, R.E. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 22p. (CONF-8510173—8). NTIS, PC A02/MF A01 - GPO. File Number TI86002055.

From 13. water reactor safety research information meeting; Gaithersburg, MD, USA (22 Oct 1985).

A multi-year program is underway at Pacific Northwest Laboratory (PNL) to move the synthetic aperture focusing technique from the Laboratory into the field to inspect light water reactor components. This report is a summary of highlights from the third year's efforts. The work presented here includes: scanner development, SAFT-UT signal processing techniques, SAFT-UT graphics package development, SAFT-UT real-time processor, SAFT-UT field system integration, SAFT-UT evaluation on CCSS, a field trip demonstrating in-field SAFT data processing, and future work. 11 figs.

7195 **(PNL-SA—128195) Status of consolidation of LWR spent fuel.** Bailey, W.J.; Beeman, G.H. (Pacific Northwest Labs., Richland, WA (USA)). Dec 1984. Contract AC06-76RL01830. 6p. (CONF-850610—40). NTIS, PC A02/MF A01; GPO Dep. File Number DE85016271.

From Annual meeting of the American Nuclear Society; Boston, MA, USA (9 Jun 1985).

One objective of the Commercial Spent Fuel Management (CSFM) Program, which is sponsored by the US Department of Energy at Pacific Northwest Laboratory (PNL), is to encourage development of technology for spent nuclear fuel rod consolidation in existing power reactor water storage basins. Rod consolidation is a leading candidate for more efficient utilization of existing space in spent fuel storage basins. The fuel and pool component integrity studies in the program provide a useful basis to establish an integrity assessment more specific to rod consolidation. 10 refs.

2102 POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 7009, 7191, 7192, 7193, 7194, 7195, 7213, 7225, 7232, 7235, 7242, 7251, 7252, 7256, 7257, 7258, 7261, 7262, 7265, 7266, 7272, 7274, 7275, 7276, 7277, 7278, 7279, 7282, 7283, 7290, 7291, 7296, 7299, 7300, 7301, 7303, 7304, 7305, 7306, 7307, 7308, 7309, 7310, 7312, 7440, 7510, 7555

7196 **(CONF-850610—46) Application of LEPRICON methodology to the unfolding of neutron fluxes in the Arkansas Nuclear One-Unit 1 reactor.** Maerker, R.E.; Broadhead, B.L.; Williams, M.L. (Oak Ridge National Lab., TN (USA); Louisiana State Univ., Baton Rouge (USA)). 1985. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85016386.

From Annual meeting of the American Nuclear Society; Boston, MA, USA (9 Jun 1985).

The LEPRICON (Least-squares EPRI CONsolidation) methodology has been gradually developed over the past few years. The system predicts the absolute neutron fluence levels as a function of energy at specified locations within the pressure vessel of an LWR from the analysis of dosimetry measurements performed at some other readily accessible surveillance location(s). LEPRICON is unique in the field of few-group spectral unfolding in that (1) it solves the extrapolation problem necessitated by the ex-situ measurements; (2) it has the capability of simultaneously unfolding a large number of spectral fluences; (3) it has the capability of simultaneously analyzing a series of benchmark experiments, along with measurements performed in an LWR; (4) it provides state-of-the-art methods for calculating the surveillance dosimeter

activities and pressure vessel spectral fluences; (5) it incorporates the basic sensitivity and covariance information necessary for estimates of the uncertainties in the original calculated quantities; and (6) it produces adjustments to the calculated quantities with uncertainties that can be significantly reduced from the original values.

7197 (DOE/ET/34212—47) Development of an advanced extended-burnup fuel assembly design incorporating urania-gadolinia. Seventh semi-annual progress report, April-September 1984. Newman, L.W.; Rodes, J.R.; Hove, C.M.; Suhocki, P.M.; Pyecha, T.D.; McInteer, W.A.; Bain, G.M.; Husser, D.L.; Papazoglou, T.P.; Aadland, P.C. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Div.; Babcock and Wilcox Co., Lynchburg, VA (USA). Research and Development Div.). Oct 1985. Contract AC02-78ET34212. 105p. (BAW—1681-7). NTIS (US Sales Only), PC A06/MF A01; GPO Dep. File Number DE86003758.

This advanced PWR fuel assembly uses a UO_2-Gd_2O_3 burnable absorber fuel mixture along with other state-of-the-art fuel performance and uranium utilization-enhancing design features that include annular pellets, annealed guide tubes, Zircaloy intermediate grids, and a removable upper end fitting. The gadolinia lead test assemblies continued their first cycle of irradiation. Also, the evaluation of cladding water-side oxide thickness data for standard Mark B fuel rods and the hot cell examination of 16 fuel rods extracted from five-cycle assembly 1D45 continued. Phase 1 of the full-batch implementation studies began in order to provide a direct comparison of lumped burnable absorber and gadolinia cycles and to identify areas requiring more investigation in Phase 2 of the studies.

7198 An experimental study of rod bundle dispersed-flow film boiling with high-pressure water. Morris, D.G.; Mullins, C.B.; Yoder, G.L. (Oak Ridge National Laboratory, Engineering Technology Division, Oak Ridge, Tennessee). *Nuclear Technology;* **69**: No. 1, 82-93(Apr 1985).

Dispersed-flow film boiling data were obtained in a large rod bundle (8 X 8) under steady-state and transient conditions with upward flowing high-pressure, high-temperature water. The bundle is equipped with detailed thermometry, and has geometry typical of later generation pressurized water reactors with 17 X 17 fuel assemblies. Comparisons with the data to empirical correlations commonly used to predict heat transfer in dispersed flow indicate that the Dougall-Rohsenow and Groeneveld-Delorme correlations overpredict and underpredict heat transfer, respectively, while the Groeneveld 5.7 and Condie-Bengston IV correlations perform reasonably well. Spacer grids are shown to cause rod surface temperature depressions of up to 100 K from the upstream to downstream side of the grid. Grid effects persist for 20 to 30 hydraulic diameters downstream of the grid.

7199 (CE-Trans—7877) Summary of erosion-corrosion observations made in power stations on wet steam circuits. Lacaille, L. Translated from *Houille Blanche ;* No. 4/5, 291-295(1981). 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901895.

In order to analyse erosion-corrosion phenomena, to discover the main parameters involved and to evaluate their relative importance, an EDF and Alsthom-Atlantique working group has systematically investigated several PWR power stations, considered as prototypes. On the basis of these observations, tests and experiments were carried out in order to assess these important parameters in liaison with the operating personnel at those power stations.

7200 (CE-Trans—7603) Proving of the nuclear power plant simulator centre of the Power Plant School from the point of view of the nuclear power station operator. Goehlich, D. Translated from *VGB Kraftwerkstechnik ;* **59**: No. 1, 14-16(Jan 1979). 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85902079.

Biblios nuclear power station ran 14 training courses on the PWR simulator at the Power Plant School in Essen. The simulator is similar to the Biblis A and B units. The simulator exercises are discussed, as is the further development of the simulator. (DLC)

2103 POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 7263, 7273, 7281, 7292

7201 Multiregion concentration diffusion coefficient determination using davidon's variable metric method. Lee, C.E.; Durkee, J.W. (Texas A&M University, Department of Nuclear Engineering, College Station, Texas). *Nuclear Technology;* **69**: No. 2, 218-235(May 1985).

An analytic solution of the one-dimensional steadystate multiregion concentration diffusion decay equation is constructed. The solution is used to determine the diffusion coefficients of metallic fission products in high-temperature gas-cooled reactor fuel particles from experimental measurement of the concentrations using Davidon's variable metric method for chi-square minimization. Typically, for two to four material regions with 50 measured concentration data points, the diffusion coefficients and their associated uncertainties can be determined rapidly (<8 s on the AMDAHL 470/V6). Using analytical solutions, the diffusion coefficients can be determined about25 times faster than using finite difference solutions. The methodology is applied to Zoller's concentration measurements of ^{137}Cs and ^{90}Sr.

2104 POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 7243

7202 (K/OP—219) Assessment of U_3O_8 requirements and fuel cycle costs resulting from thorium fuel cycle in HWRs (CANDUs). Gift, E.H. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 17 Jan 1977. Contract AC05-84OT21400. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003587.

Based on available, published information, it is apparent that the CANDU heavy water reactor requires a significantly lower lifetime U_3O_8 supply than a comparably operated light water reactor. Thorium utilization in the CANDU system has the potential of requiring only 30 to 35% as much fuel, at realistic conversion ratios (0.85 to 0.9), as a no recycle CANDU. This advantage is partially offset by the much higher initial U_3O_8 and fissile requirements of the thorium fueled options. The effect of an expanding nuclear power system tends to amplify these higher front end U_3O_8 requirements. For example, at a growth rate of five reactors per year, 11 years are required before the fuel requirements for a thorium fueled CANDU (conversion ratio = 0.85) become less than those of a CANDU-no recycle and between 27 and 30 years before they are less than those of a CANDU system on plutonium recycle. The economics of thorium utilization seem to be marginal (as a consequence of high recovery costs) for plutonium makeup recovered from CANDU fuels, but may be competitive operating on U-235 makeup. A definite economic optimum seems to exist for conversion ratios between 0.8 and 0.9, based on present cost concepts.

2105 POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 7231, 7244, 7245, 7246, 7248, 7273, 7554

7203 (CONF-851007—14) Steady state temperature profiles in two simulated liquid metal reactor fuel assemblies with identical design specifications. Levin, A.E.; Carbajo, J.J.; Lloyd, D.B.; Montgomery, B.H.; Rose, S.D.; Wantland, J.L. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002258.

From 3. international meeting on reactor thermal hydraulics; Newport, RI, USA (15 Oct 1985).

Temperature data from steady state tests in two parallel, simulated liquid metal reactor fuel assemblies with identical design specifications have been compared to determine the extent to which they agree. In general, good agreement was found in data at low

flows and in bundle-center data at higher flows. Discrepancies in the data wre noted near the bundle edges at higher flows. An analysis of bundle thermal boundary conditions showed that the possible eccentric placement of one bundle within the housing could account for these discrepancies.

7204 **(CONF-851115—30) Impact of ^{57}Fe on neutron penetration in thick sodium-iron shields.** Fu, C.Y.; Ingersoll, D.T. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002180.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The latest release of the VITAMIN-E multigroup cross-section library contains two different versions of neutron cross sections for natural iron, one based on ENDF/B-V MOD-1, and the other on MOD-3. The isotope ^{57}Fe has four inelastic-scattering levels below 846 keV, the energy of the first excited state in ^{56}Fe. The importance of the new cross sections was investigated by using both VITAMIN-E versions of the iron cross sections in S_8P_3 174 group ANISN calculations for two Na-Fe shield configurations. In neutron penetration calculations through thick steel regions, ^{57}Fe can be 10 times more important than is indicated by its isotopic abundance in natural iron. The 14.4-keV inelastic level of ^{57}Fe is sufficiently important that it may be worthwhile to perform a measurement of this cross section to validate the ENDF/B-V MOD-3 value, which was obtained from nuclear model calculations. Shielding analyses were done with iron cross sections predating ENDF/B-V MOD-3 should be reviewed and may need to be revised.

2107 REGULATION AND LICENSING

REFER ALSO TO CITATION(S) 7269

7205 **(NUREG—0750-Vol.12-No.3) Indexes to Nuclear Regulatory Commission Issuances, July-September 1980.** (Nuclear Regulatory Commission, Washington, DC (USA)). 1980. 44p. NTIS, PC A03/MF A01 - GPO. File Number TI86900076.

Issuances of the Atomic Safety and Licensing Board (ASLB), the Atomic Safety and Licensing Appeal Boards (ALAB), the Administrative Law Judge (ALJ), regulatory issuances of the Commission (CLI), the Directors Denial (DD), and the Denials of Petitions for Rulemaking for the period July through September 1980 appear in Nuclear Regulatory Commission Issuances, 12 NRC No. 1, Pages 1 - 136, through 12 NRC No. 3, Pages 253 - 406. Digests and indexes for these issuances are presented in this document. These digests and indexes are intended to serve as a guide to the issuances.

7206 **(NUREG—0750-Vol.21-Index2) Indexes to Nuclear Regulatory Commission Issuances: Index 2, January-June 1985.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). 1985. 104p. NTIS, PC A06/MF A01 - GPO. File Number TI86900127.

Digests and indexes for issuances of the Commission (CLI), the Atomic Safety and Licensing Appeal Panel (ALAB), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions of Rulemaking are presented in this document. These digests and indexes are intended to serve as a guide to the issuances.

7207 **(NUREG—0750-Vol.22-No.3) Nuclear Regulatory Commission Issuances.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Sep 1985. 198p. NTIS, PC A09/MF A01 - GPO. File Number TI86900336.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

2108 ECONOMICS

REFER ALSO TO CITATION(S) 7033, 7202, 7264, 7308

7208 **(BNL-NUREG—36888) Adequacy of human reliability data for addressing risk reduction issues at commercial nuclear power plants.** Ryan, T.G.; O'Brien, J.N.; Spettell, C.M. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Risk Analysis and Operations; Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 8p. (CONF-8506100—6). NTIS, PC A02/MF A01 - GPO. File Number TI85018489.

From 3. IEEE conference on human factors and power plants; Monterey, CA, USA (23 Jun 1985).

This paper describes the results of an assessment of how well currently available Probabilistic Risk Assessment (PRA) data address a representative set of human risk issues of current concern to the US Nuclear Regulatory Commission (NRC). A three-step process was used to make that assessment. First, all Human Reliability Analysis (HRA) data included in 19 PRAs were identified, collected, and stored on a computer. Second, a list of human risk "working level issues" of concern to NRC was compiled. Finally, the HRA/PRA data which were collected from 19 PRAs were compared to the data needs to assess the extent to which currently available PRA data are useful in addressing human risk issues of concern to NRC. Less than 1% of the data needs were determined to be addressed by currently available PRA data. Findings indicate that PRA data could be far more useful in addressing human risk issues with modification of the development process and documentation structure of PRAs. In addition, information from non-PRA sources could be integrated with PRA data to address many other issues. 7 refs., 13 tabs.

7209 **(CONF-7803135—3) [International fuel cycle evaluation].** Giambusso, A. (Energy Research and Development Administration, Washington, DC (USA)). 1978. 23p. NTIS, PC A02. File Number DE85018261.

From Fuel cycle conference; New York, NY, USA (5 Mar 1978).

The origins and development of the International Fuel Cycle Evaluation, its organization, and US role and objectives are discussed.

7210 **(ERDA—021) Status and future direction of US fuel cycle R and D.** Cunningham, G.W. (Energy Research and Development Administration, Washington, DC (USA)). 26 Apr 1977. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85018242.

The new directions which ERDA nuclear fuel cycle programs are taking in response to the recently announced Presidential directives are discussed.

7211 **(NRC—5902169) NRC report to Congress on the status of domestic and international evaluations of nuclear reactor and fuel cycle systems.** (Nuclear Regulatory Commission, Washington, DC (USA)). Nov 1979. 37p. NTIS, PC A03/MF A01 - GPO. File Number TI85902169.

This is the first semi-annual report and covers NRC activities in alternative reactor and fuel cycle evaluations prior to June 30, 1979. Events occurring after this date will be covered in subsequent reports to Congress in this series. Section II of this report references pertinent documentation. Section III provides a summary of NRC comments on alternative reactor and fuel cycle systems described in reports that were reviewed. Section IV summarizes applicable NRC research and technical assistance on alternative reactor and fuel cycle concepts. Section V provides additional comments. Identification and description of alternative reactors and fuel cycles by DOE are still being developed and the leading technologies are yet to be delineated. Nonproliferation Alternative Systems Assessment Program (NASAP) and International Nuclear Fuel Cycle Evaluation (INFCE) final reports will not be available until late this year or early next year. To this date NRC has made only preliminary reviews of draft NASAP and INFCE documents.

7212 **(NUREG/CR—4104) Maintenance Personnel Performance Simulation (MAPPS) model: field evaluation/validation.** Knee, H.E.; Siegel, A.I.; Wolf, J.J.; Bartter, W.D.; Madden, E.G.; Kopstein, F.F. (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 82p. (ORNL/TM—9503). NTIS, PC A05/MF A01 - GPO. File Number TI85018127.

This report presents the results of critical analyses of the practicality, acceptability, usefulness, and validity of the MAintenance Personnel Performance Simulation (MAPPS) model. An overview of the principal issues considered in each analysis is given. This program which has developed the MAPPS computer simulation model is part of a larger Nuclear Regulatory Commission (NRC) research program whose immediate goal is to develop a technical support system for reliability evaluation at nuclear power plants, especially those employing probabilistic risk assessment (PRA) methodologies. 12 refs., 15 figs., 20 tabs.

2109 PROCESS HEAT REACTORS

7213 **Technical feasibility and economics of retrofitting an existing nuclear power plant to cogeneration operation for hot water district heating.** Kolb, J.O. (Energy Division, Oak Ridge National Laboratory, Oak Ridge, TN). *American Society of Mechanical Engineers, [Paper];* No. 84-JPGC-NE-5, vp(Sep 1984). (CONF-840905—).

From Joint power generation conference; Toronto, Canada (30 Sep 1984).

This paper presents the results of a study of the hypothetical conversion of two 560-MW(t) PWR plant turbines to cogeneration operation to supply a future hot water district heating system load in the Twin Cities of Minneapolis-St. Paul (Ref. 1). The conceptual design of the nuclear turbine retrofitted for cogeneration and of a hot water transmission system has been performed, and the capital investment and annual owning and operating costs have been estimated for thermal energy capacities of 600 and 1200 MW(t). Unit cost of thermal energy for cogenerated hot water at the nuclear plant gate has been estimated to be competitive with the cost from a coalfired cogeneration plant. The unit cost of delivered thermal energy was based on a 36-mile-long (57.9-km) transmission route between the Twin Cities and the Prairie Island Nuclear Plant. Major variables considered in this study include: (1) inclusion of back-pressure turbines in the retrofitted nuclear steam system to maximize cycle efficiency; (2) transmission system delivery capacities of 600 MW(t) and 1,200 MW(t) corresponding with a retrofit of one or two nuclear turbines; (3) reduced transmission distances from the 36-mile system design basis; (4) the effect of fixed charge rates on the capital investment costs ranging from 15 to 21% per year; and (5) effect of "firm" vs "oil-interruptible" service modes on the annual unit cost of delivered thermal energy.

7214 **National need for utilizing nuclear energy for process heat generation.** Gambill, W.R.; Kasten, P.R. (Oak Ridge National Laboratory Oak Ridge, TN). *American Society of Mechanical Engineers, [Paper];* No. 84-JPGC-NE-15, 7(Sep 1984). (CONF-840905—).

From Joint power generation conference; Toronto, Canada (30 Sep 1984).

A number of reactor types can be utilized to generate nuclear process heat; those considered here are light water reactors (LWRs), heavy water reactors (HWRs), gas cooled reactors (GCRs), and liquid metal reactors (LMRs). LWRs and HWRs can generate process heat up to 280°C, LMRs up to 540°C, and GCRs up to 950°C. Based on the studies here, the total estimated United States process heat market corresponds to 310-370 GW(t) after the year 2025, with 75-120 GW(t) for process steam (temperatures less than 260°C), 20-35 GW(t) for process heat (temperatures greater than 260°C but less than 540°C), 30 GW(t) for district heating, 30 GW(t) for resource recovery, 85 GW(t) for chemicals production, and 70 GW(t) for synthetic fuels production. The above reactor types can contribute to these different markets in accordance with their coolant temperature capability.

22 NUCLEAR REACTOR TECHNOLOGY

2201 THEORY AND CALCULATION

7215 **(CONF-851115—28) Adjoint-based sensitivity analysis for reactor accident codes.** Parks, C.V. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002190.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

This paper summarizes a recently completed study that identified and investigated the difficulties and limitations of applying first-order adjoint sensitivity methods to reactor accident codes. The work extends earlier adjoint sensitivity formulations and applications to consider problem/model discontinuities in a general fashion, provide for response (R) formulations required by reactor safety applications, and provide a scheme for accurately handling extremely time-sensitive reactor accident responses. The scheme involves partitioning (dividing) the model into submodels (with spearate defining equations and initial conditions) at the location of discontinuity. Successful partitioning moves the problem dependence on the discontinuity location from the whole model system equations to the initial conditions of the second submodel.

7216 **(CONF-851115—31) Extension of the linear nodal method to large concrete building calculations.** Childs, R.L.; Rhoades, W.A. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01 - GPO. File Number TI86002187.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The implementation of the linear nodal method in the TORT code is described, and the results of a mesh refinement study to test the effectiveness of the linear nodal and weighted diamond difference methods available in TORT are presented.

7217 **(CONF-8410256—3) Background information on neutron flux for an advanced high-flux reactor.** Moon, R.M. (Oak Ridge National Lab., TN (USA)). Jan 1985. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002268.

From Workshop on scientific opportunities with advanced facilities for neutron scattering; Shelter Island, NY, USA (23 Oct 1984).

This paper assumes a large D_2O reflector equipped with cold source(s), a hot source, and with a peak thermal flux in the reflector of $phi_0 = 5 \times 10^{15}$ ncm^{-2} sec^{-1}. The flux distributions for thermal, cold, and hot beams are estimated. The equations required to calculate neutron intensities delivered by beam tubes and guides are summarized and some expected intensities are given for the assumed 5×10^{15} reactor. In addition, the equations needed to calculate monochromatic intensities delivered to the sample by a crystal monochromator are given.

7218 **(LA—10465-PR) Radiation transport. Progress report, October 1, 1984-December 31, 1984.** O'Dell, R.D. (Los Alamos National Lab., NM (USA)). Aug 1985. Contract W-7405-ENG-36. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86003291.

Research and development progress in radiation transport by the Los Alamos Laboratory's Group X-6 for the first quarter of FY 85 is reported. Included are unclassified tasks in the areas of Deterministic Radiation Transport, Monte Carlo Radiation Transport, and Cross Sections and Physics. 50 refs.

7219 **(NUREG/CR—4396) SIMMER postprocessor manual.** Parker, F.R. (Los Alamos National Lab., NM (USA)). Oct 1985. Contract W-7405-ENG-36. 137p. (LA—10549-M). NTIS, PC A07/MF A01 - GPO. File Number TI86003266.

The T6P postprocessor analyzes SIMMER-II TAPE6 and TAPE36 data. The processor calculates new variables, integrates variables over regions of the mesh, compares values of a variable of

a given problem at selected times, compares values of a variable at selected times between problems for parameter studies, calculates derivatives of a variable at a requested location in the mesh over time. The data are presented to the user graphically, using two-dimensional graphs and three-dimensional perspective or contour plots. Interactive graphic techniques may be used with perspective plots.

7220 **(PNL-tr—452) Neutron interaction in air of cylindrical receptacles containing uranium solutions or plutonium solutions.** Bouly, J.C. (Pacific Northwest Labs., Richland, WA (USA)). 19 Aug 1985. Contract AC06-76RL01830. Translation of CEA-R-3946, 1985. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001605.

The neutron interaction between equipment units, and particularly between storage receptables, is an important aspect of the study of criticality safety of facilities for treatment of fissile materials. The study of the interaction of unshielded receptacles in air is relatively simple. Such a study becomes tricky and complex for interaction in the presence of partial moderator shields and for interaction in the presence of both partial moderator shields and multiple reflectors. Already completed tests as well as tests which are being undertaken will permit the checking of theoretical methods used for computations of interactions in the facilities. This report deals solely with neutron interaction in the air. A later report will discuss the effects of various shields and reflectors (concrete, paraffin wax, permali, plexiglass, bitumen, etc.) on this interaction.

2202 COMPONENTS AND ACCESSORIES

7221 **(CONF-8510221—1) Emergency ac power systems operating experience at US nuclear power plants, 1976 through 1983.** Battle, R.E. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002250.

From Committee on the Safety of Nuclear Installations (CSNI) specialist meeting on operating experience relating to on-site electric power sources; London, UK (16 Oct 1985).

Success and failure data of test and emergency starts of emergency ac power sources (diesel generators) at US nuclear power plants were collected and evaluated to estimate diesel generator reliability parameters. A regression analysis of the estimates of the probability of failure to start based on surveillance test data from 1976 through 1983 indicates that the probability of failure to start has been decreasing. However, the reliability of diesel generator performance during losses of off-site power for 1981 through 1983 was less than expected based on the test data estimates. The failures that occurred during losses of off-site power were reviewed to determine why the calculated failure to start was greater than expected, and possible explanations for this high value are presented. The subsystems involved in diesel generator subsystem failures were categorized to determine whether there were any dominant failure modes. The results indicate that further significant improvement in diesel generator reliability will require improvement of many subsystems.

7222 **(EGG-M—17284) Distributions of component failure rates estimated from LER data.** Atwood, C.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 9p. (CONF-850206—32). NTIS, PC A02/MF A01; GPO Dep. File Number DE85016155.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

Past analyses of Licensee Event Report (LER) data have noted that component failure rates vary from plant to plant, and have estimated the distributions by two-parameter gamma distributions. In this study, a more complicated distributional form is considered, a mixture of gammas. This could arise if the plants' failure rates cluster into distinct groups. The method was applied to selected published LER data for diesel generators, pumps, valves, and instrumentation and control assemblies. The improved fits from using a mixture rather than a single gamma distribution were minimal, and not statistically significant. There seem to be two possibilities: either explanatory variables affect the failure rates only in a gradual way, not a qualitative way; or, for estimating individual component failure rates, the published LER data have been analyzed to the limit of resolution. 9 refs.

7223 **(NUREG/CR—4146) Simulation of an EPRI-Nevada Test Site (NTS) hydrogen burn test at the Central Receiver Test Facility.** Dandini, V.J.; Aragon, J.J. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1985. Contract AC04-76DP00789. 76p. (SAND—85-0205). NTIS, PC A05/MF A01 - GPO. File Number TI86001633.

In order to augment results obtained from the hydrogen burn equipment survival tests performed by the Electric Power Research Institute (EPRI) at the Nevada Test Site (NTS), a series of tests was conducted at the Sandia National Laboratories Central Receiver Test Facility (CRTF). The CRTF tests simulated a 13 volume-percent burn from the EPRI-NTS series. During the CRTF tests, the thermal and operational responses of several specimens of nuclear power plant safety-related equipment were monitored when subjected to a solar heat flux simulation of a hydrogen burn. The simulation was conducted with and without steam in the vicinity of the test specimens. Prior to exposure, the specimens were preheated to temperatures corresponding to the precombustion environment in the EPRI-NTS test vessel.

7224 **Sealing coupling.** Pardini, J. A.; Brubaker, R. C.; Rusnak, J. J. (to The United States of America as represented by the United States Department of Energy). US Patent 4,515,750. 7 May 1985. Filed date 20 Sep 1982. vp.

PAT-APPL-420070.

Disclosed is a remotely operable releasable sealing coupling which provides fluid-tight joinder of upper and a lower conduit sections. Each conduit section has a concave conical sealing surface adjacent its end portion. A tubular sleeve having convex spherical ends is inserted between the conduit ends to form line contact with the concave conical end portions. An inwardly projecting lip located at one end of the sleeve cooperates with a retaining collar formed on the upper pipe end to provide swivel capture for the sleeve. The upper conduit section also includes a tapered lower end portion which engages the inside surface of the sleeve to limit misalignment of the connected conduit sections.

2203 FUEL ELEMENTS

7225 **(TVA/PE/NP—85/14) Tennessee Valley Authority nuclear fuel performance.** Rahn, B.; Gardner, D. (Tennessee Valley Authority, Chattanooga (USA)). 1985. 23p. (CONF-8509191—1). NTIS, PC A02/MF A01. File Number DE86900230.

From 16. international utility nuclear fuel performance conference; Dallas, TX, USA (30 Sep 1985).

The Browns Ferry BWR units started operation in the early to mid 1970s, and the Sequoyah PWR units started in the very early 1980s. Operating dates, outage length, capacity factor, and cycle exposure are given for these units. This paper deals with fuel performance at the Browns Ferry and Sequoyah plants. Leaks, off-gas, fraction failed, iodine-131, and corrosion are covered. 14 figs.

7226 **Fuel rod retention device for a nuclear reactor.** Hylton, Ch. L. (to The United States of America as represented by the United States Department of Energy). US Patent 4,452,755. 5 Jun 1984. Filed date 29 Jan 1982. vp.

PAT-APPL-343793.

A device is described for supporting a nuclear fuel rod in a fuel rod assembly which allows the rod to be removed without disturbing other rods in the assembly. A fuel rod cap connects the rod to a bolt which is supported in the assembly end fitting by means of a locking assembly. The device is designed so that the bolt is held securely during normal reactor operation yet may be easily disengaged and the fuel rod removed when desired.

2204 CONTROL SYSTEMS

REFER ALSO TO CITATION(S) 7290

7227 **(BMI—1985-075) Optimization of the education of responsible shift personnel in nuclear power plants.** (Bundesministerium des Innern, Bonn (Germany, F.R.); VGB Technische Vereinigung der Grosskraftwerksbetreiber e.V., Essen (Germany, F.R.)). May 1985. 205p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86750281.

The investigation is restricted to responsible shift personnel. In this way a clearly defined circle of people can be considered, independent of operational organisation structures. The function of this group is comparable among the individual nuclear power stations. The study concerning this contains an analysis of the activities, and also the investigation and description of the required abilities, knowledge and learning objectives. The operator attaches particular significance to educational instruction on reactor simulators.

7228 **(BMI—1985-075/1) Optimising the education of responsible shift personnel in nuclear power plants. Volume 1 for Chapter 3: Investigational methodology.** (Bundesministerium des Innern, Bonn (Germany, F.R.); VGB Technische Vereinigung der Grosskraftwerksbetreiber e.V., Essen (Germany, F.R.)). May 1985. 71p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86750282.

In line with the usual announcement procedures, an analysis was to be carried out of those activities from which capabilities, knowledge and then learning objectives can be derived in consecutive stages. In this respect, this volume contains articles on the following: the derivation of learning objectives from activities on the themes of capabilities and knowledge; the analysis of professional activity; the appraisal of the descriptors and a textual presentation of the activities.

7229 **(BMI—1985-075/2) Optimising the education of responsible shift personnel in nuclear power plants. Volume 2 for Chapter 4: General areas of staff education.** (Bundesministerium des Innern, Bonn (Germany, F.R.); VGB Technische Vereinigung der Grosskraftwerksbetreiber e.V., Essen (Germany, F.R.)). May 1985. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86750283.

Themes are discussed which have not in fact become learning objectives, but which nevertheless influence the education of shift personnel. This volume contains articles on the following: the influence factors of human error; the demands on a simulator for the education of shift personnel; technical aids for supporting stuff and principles of leadership and motivation.

7230 **(DP-MS—85-63) Plant experience with an expert system for alarm diagnosis.** Gimmy, K.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1986. Contract AC09-76SR00001. 4p. (CONF-860119—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001966.

From Society for Computer Simulation (SCS) multiconference; San Diego, CA, USA (23 Jan 1986).

An expert system called Diagnosis of Multiple Alarms (DMA) is in routine use at four nuclear reactors operated by the DuPont Company. The system is wired to plant alarm annunciators and does event-tree analysis to see if a pattern exists. Any diagnosis is displayed to the plant operator and the corrective procedure to be followed is also identified. The display is automatically superseded if a higher priority diagnosis is made. The system is integrated with operator training and procedures. Operating results have been positive. DMA has diagnosed several hard-to-locate small leaks. There have been some false diagnosis, and realistic plant environments must be considered in such expert systems. 2 refs., 5 figs.

7231 **(HEDL-SA—3278) MIDAS: an effective tool for work management.** Ball, D.L.; Billings, M.P.; McCargar, S.B.; Talbot, M.D.; Topping, C.F. (Hanford Engineering Development Lab., Richland, WA (USA)). 1985. Contract AC06-76FF02170. 8p. (CONF-850903—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE85018468.

From International topical meeting on computer applications for nuclear power plant operation and control; Pasco, WA, USA (8 Sep 1985).

The computerized Master Information Data Acquisition System (MIDAS) is used to control work at facilities that support the Liquid Metal Reactor (LMR) program on the Hanford Site at Richland, Washington. Functions of this software system are to: track authorized maintenance activities, enhance operational safety, track schedule, manpower, and material constraints during work preparation, provide a management tool for quality measurement techniques, and provide an overall repository for technical and safety-related information on components at the Hanford Site 400 Area facilities. This paper describes MIDAS and how it is used as a work management tool. 1 fig.

2205 ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 7009, 7193, 7280

7232 **(EGG-PBS—7002) Technical evaluation of RETS-required reports for Zion Nuclear Power Station, Units 1 and 2 for 1983.** Young, T.E.; Magleby, E.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 7 Aug 1985. Contract AC07-76ID01570. 58p. NTIS, PC A04/MF A01 - GPO. File Number TI86003258.

A review was performed on the reports required by Federal regulations and the plant-specific Radiological Effluent Technical Specifications (RETS) for operations conducted at Commonwealth Edison's Zion Nuclear Power Station during 1983. The two periodic reports reviewed: (1) were the Effluent and Waste Disposal Semiannual Report, July-December 1983, and (2) the Radioactive Waste and Environmental Monitoring Annual Report - 1983. The principal review guidelines were the plant's specific RETS and NRC guidance given in NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants." The Licensee's submitted reports were found to be reasonably complete and consistent with the review guidelines.

7233 **(NUREG/CR—1100) Evaluation of impingement losses of white perch at the Indian Point Nuclear Station and other Hudson River power plants.** Van Winkle, W.; Barnthouse, L.W.; Kirk, B.L.; Vaughan, D.S. (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract AC05-84OR21400. 147p. (ORNL/NUREG/TM—361). NTIS, PC A07/MF A01 - GPO. File Number TI86000154.

Environmental Sciences Division Publication No. 1480.

This report evaluates two independent lines of evidence concerning impingement losses of white perch at the power plants on the Hudson River. Based on regression analyses of impingement rate as an index of year-class strength versus year over the period 1972 through 1977, it is concluded that there is little evidence of a statistically significant downward trend. However, an analysis of minimum detectable differences in impingement rates indicates that a long time series of year-class strength would be required to detect even substantial reductions (e.g., 50%). Second, based on our estimates of percent reduction in year-class strength due to impingement (> 20% for the 1974 year class and >15% for the 1975 year class), it is concluded that the level of impingement impact is not acceptable a priori from the point of view of managing the white perch population. Our methodologies and results are compared with those of the utilities, and the bases for the substantial differences in estimate of impingement are discussed. Appendices are included on survival of impinged white perch, impingement rate as an index of population abundance, and ability to detect decreases in population abundance. 57 refs., 29 tabs.

7234 (NUREG/CR—4360-Vol.1) Calculational methods for analysis of postulated UF_6 releases. Williams, W.R. (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 132p. (ORNL/ENG/TM—31/V1). NTIS, PC A07/MF A01 - GPO. File Number TI86002977.

Calculational methods and computer programs for the analysis of source terms for postulated releases of UF_6 are presented. Required thermophysical properties of UF_6, HF, and H_2O are described in detail. UF_6 reacts with moisture in the ambient environment to form HF and H_2O. The coexistence of HF and H_2O significantly alters their pure component properties, and HF vapor polymerizes. A release rate model of UF_6 is presented that considers the transient conditions inside containment and the flashing, multiphase flow of UF_6 along the release pathway. Transient compartment models for simulating UF_6 releases inside rooms ventilated by forced- and induced-draft systems are also described. The basic compartment model mass and energy balances are supported by simple heat transfer, ventilation system, and deposition models. A model that can simulate either a closed compartment or a steady-state ventilation system is also discussed. Listings of all main programs (including two plotting routines) and subroutines are included. Example problems illustrate the analysis of postulated releases using the described programs. 12 refs., 45 figs., 31 tabs.

2206 RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 7218, 7260, 8044

7235 (CONF-851115—8) In-core and ex-core calculations of the VENUS simulated PWR benchmark experiment. Williams, M.L.; Chowdhury, P.; Landesman, M.; Kam, F.B.K. (Louisiana State Univ., Baton Rouge (USA); Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01. File Number TI85014660.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The VENUS PWR engineering mockup experiment was established to simulate a beginning-of-life, generic PWR configuration at the zero-power VENUS critical facility located at CEN/SCK, Mol, Belgium. The experimental measurement program consists of (1) gamma scans to determine the core power distribution, (2) in-core and ex-core foil activations, (3) neutron spectrometer measurements, and (4) gamma heating measurements with TLD's. Analysis of the VENUS benchmark has been performed with two-dimensional discrete ordinates transport theory, using the DOT-IV code.

7236 (CONF-8405192—2) Summary of workshop recommendations. Moon, R.M. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85016150.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

The recommendations by the various groups regarding instrumentation are summarized. Almost all the instruments have been recommended by more than one workshop group. This indicates that a multidisciplinary group should be involved in detailed planning and design for these instruments. To judge whether the preliminary plans for beam facilities are consistent with these workshop recommendations, it is assumed that three instruments can be installed on a guide and one instrument on a horizontal or slant beam tube.

7237 (CONF-8410173—14) Measurements of the HEU and LEU in-core spectra at the Ford Nuclear Reactor. Wehe, D.K.; King, J.S.; Lee, J.C.; Martin, W.R. (Oak Ridge National Lab., TN (USA); Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). 1984. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002259.

From International meeting on reduced enrichment for research and test reactors; Argonne, IL, USA (14 Oct 1984).

The Ford Nuclear Reactor (FNR) at the University of Michigan has been serving as the test site for a low-enriched uranium (LEU) fuel whole-core demonstration. As part of the experimental program, the differential neutron spectrum has been measured in a high-enriched uranium (HEU) core and an LEU core. The HEU and LEU spectra were determined by unfolding the measured activities of foils that were irradiated in the reactor. When the HEU and LEU spectra are compared from 1 MeV to 10 MeV, significant differences between the two spectra are apparent below 10 eV. These are probably caused by the additional ^{238}U resonance absorption in the LEU fuel. No measurable difference occurs in the shape of the spectra above 1 MeV. 7 refs., 6 figs., 2 tabs.

7238 (HEDL-SA—3323-FP) Fuel assembly cooling experience at the FFTF/IEM cell. McGuinness, P.W. (Hanford Engineering Development Lab., Richland, WA (USA)). 1985. Contract AC06-76FF02170. 7p. (CONF-851115—16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85018501.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

In the Fast Flux Test Facility (FFTF), sodium wetted irradiated fuel assemblies are discharged to the Interim Examination and Maintenance (IEM) Cell for disassembly and post-irradiation examination in an inert argon atmosphere. While in the IEM Cell, fuel assemblies are cooled by the IEM Cell Subassembly Cooling System. This paper describes the cooling system design, performance, and lessons learned, including a discussion of two overtemperature incidents. 2 refs., 6 figs.

7239 (HEDL-SA—3333-FP) Fuel assembly cooling: grapple seals in the FFTF/IEM cell. Gibbons, P.W. (Hanford Engineering Development Lab., Richland, WA (USA)). 1985. Contract AC06-76FF02170. 5p. (CONF-851115—17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85018474.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

High temperature, extremely severe environment seals are vital for adequate cooling flow when transferring high decay heat driver fuel assemblies with the Interim Examination and Maintenance Cell at the Fast Flux Test Facility. The data from a multimillion dollar fuel assembly experiment would be invalidated if internal temperatures were allowed to exceed normal maximum operating temperatures. Cooling is accomplished by drawing cell atmosphere through the assembly by means of a ducted grapple. For this to be effective, an adequate grapple/fuel assembly interface seal had to be found. A silicone rubber seal was designed and tested that is both compliant (for leak tightness) and capable of surviving in enviroments not normally considered compatible with such materials. 4 figs., 1 tab.

7240 (ORNL/TM—9870) Operating manual for the Health Physics Research Reactor. (Oak Ridge National Lab., TN (USA)). Nov 1985. Contract AC05-84OR21400. 178p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86003556.

This manual is intended to serve as a guide in the operation and maintenance of the Health Physics Researh Reactor (HPRR) of the Health Physics Dosimetry Applications Research (DOSAR) Facility. It includes descriptions of the HPRR and of associated equipment such as the reactor positioning devises and the derrick. Procedures for routine operation of the HPRR are given in detail, and checklists for the various steps are provided where applicable. Emergency procedures are similarly covered, and maintenance schedules are outlined. Also, a bibliography of references giving more detailed information on the DOSAR Facility is included. Changes to this manual will be approved by at least two of the following senior staff members: (1) the Operations Division Director, (2) the Reactor Operations Department Head, (3) the Supervisor of Reactor Operations TSF-HPRR Areas. The master copy and the copy of the manual issued to the HPRR Operations Supervisor will always reflect the latest revision. 22 figs.

7241 **(CE-Trans—7653) Absorption of self-excited vibrations.** Hagedorn, P. Translated from *Zeitschrift fuer Angewandte Mathematik und Physik ;* 29: 815-821(1978). 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85902134.

This report is concerned with the suppression of self-excited vibrations and the absorption thereof. Technical applications of the suppression of self-excited vibrators are also indicated.

7242 **(EGG/EOS—Vol.2-NNE-L1-5-Rev.1) LOFT experiment specification. Volume 2. Nonnuclear Test Series L1 Experiment 5. Revision 1.** Welland, H.J.; Harris, P.A.; Samuels, T.K. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1977. Contract AC07-76ID01570. 135p. NTIS, PC A07/MF A01 - GPO; GPO Dep. File Number TI85016657.

Volume 1 of the LOFT Experiment Operating Specifications (EOS) identifies and briefly describes the experiments to be performed. Volume 2 of the EOS describes the specific test requirements, e.g., initial system configuration, initial test conditions, operating conditions, and detailed measurements requirement, which have programmatic significance. Appendix A to EOS Volume 2 provides justification for the selection of specific operating parameters. One of the major purposes of the LOFT nonnuclear loss-of-coolant experiments (LOCEs) of Test Series L1 is to make available large scale isothermal blowdown and reflood system data as a first phase of the LOFT Program. The general requirements are specified in the LOCA Verification Program Description and EOS Volume 1. 22 refs.

7243 **(CE-Trans—7613) Use of Mg-Zr alloy as a canning material.** Bernard, J.L.; Boudouresques, B. Translated from *Journal of Nuclear Materials ;* 8: No. 1, 3-11(1963). 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86900169.

Work on the magnesium-zirconium binary alloy dates back to 1951, a time for finding a canning material for the fuel elements for the EL 2 (D_2O - CO_2) reactor. Nevertheless, in view of the mild operating conditions in this reactor and also the far from complete knowledge of this alloy at the time, it was 1956 before it was used as a canning metal. In this case it was used for the first French CO_2-cooled, graphite moderated reactor, i.e. the G2. The first concern, when looking at Mg-Zr alloys, was to remedy the mediocre properties, due to the extremely coarse crystallization, of non-alloyed magnesium, and the majority of its alloys. In 1937-38 Sauerwald had shown the considerable ability of zirconium to refine the grain structure of magnesium. 10 figs.

2207 PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

REFER ALSO TO CITATION(S) 8121

2209 REACTOR SAFETY

REFER ALSO TO CITATION(S) 7215, 7230, 7242, 7440, 7674

7244 **(BNL-NUREG—28940) Quantification of dependent failures of high population components of a fault tree.** Jamali, K.M. (Brookhaven National Lab., Upton, NY (USA)). Jun 1981. Contract AC02-76CH00016. 6p. (CONF-810606—112). NTIS, PC A02/MF A01 - GPO. File Number TI86000110.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

This paper describes a methodology for identification and quantification of the significant dependent failures of high population components of a system fault tree. The accuracy of the approach is essentially limited by the exactness of the available conditional failure data. It uses a single iteration scheme for each group of high population components and the properties of the fault tree together with the data on the probabilities of multiple failures. 6 refs., 1 fig.

7245 **(BNL-NUREG—28942) Analysis of loss-of-piping integrity accidents in pool-type LMFBRs using SSC-P.** Khatib-Rahbar, M.; Cazzoli, E.G.; Madni, I.K. (Brookhaven National Lab., Upton, NY (USA); University of Petroleum and Minerals, Dhahran (Saudi Arabia)). 1981. Contract AC02-76CH00016. 6p. (CONF-810606—113). NTIS, PC A02/MF A01 - GPO. File Number TI86000112.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

A need therefore exists in this country for a generalized system simulation code which could be used as an available tool for the regulatory body for the safety analysis of pool-type LMFBR plants. For this reason, the SSC-P, a version in the Super System Code series, has been developed. SSC-P is a generalized computer program capable of simulating a variety of operational, incidental and accidental transients with particular emphasis on transients involving plant protection and plant control systems. In this paper, application of the SSC-P code to analyze loss-of-piping integrity (LOPI) accidents in pool-type plants is discussed; some parallel comparisons are made to loop-type systems, using PHENIX and CRBRP systems as reference designs.

7246 **(BNL-NUREG—28954) Boiling inception in volume-heated liquids.** Greene, G.A.; Reilly, S.M. (Brookhaven National Lab., Upton, NY (USA); Massachusetts Inst. of Tech., Cambridge (USA)). 1981. Contract AC02-76CH00016. 8p. (CONF-810606—111). NTIS, PC A02/MF A01. File Number TI86000114.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

Analysis of the transition phase of a hypothetical core disruptive accident in an LMFBR has indicated that the core would probably consist of a boiling mixture of fuel and steel, temporarily confined by massive blockages of fuel and/or steel, both above and below. Recriticality of the core depends to a great extent upon the hydrodynamic state of the fuel/steel mixture. Experiments have been performed with non-reactor materials to determine the behavior of such pools, in particular the average and local distribution of vapor. These experiments indicate that one dimensional drift flux calculations are not satisfactory for determining void profiles in internally boiling liquids, since they neither predict the boiling onset and stratified behavior nor agree with measured void profile data. This observation casts serious doubt upon the applicability of hydrodynamic analog experiments for determination of void distribution behavior of volumetrically boiling liquids. Further analysis is underway to develop appropriate models for the prediction of vapor distribution in volume-heated liquids to include determination of boiling onset as well as subsequent void fraction distribution. 9 refs., 2 figs.

7247 **(BNL-NUREG—29836) TRAC-PD2 prediction of a FLECHT-SEASET bottom forced reflood experiment.** Neymotin, L. (Brookhaven National Lab., Upton, NY (USA)). Jul 1981. Contract AC02-76CH00016. 8p. (CONF-811103—137). NTIS, PC A02/MF A01 - GPO. File Number TI86000889.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

TRAC-PD2 modified to include the BNL corrections predicted a rod surface temperature behavior which agreed reasonably well with the experimental data (within the experimental scatter bounds) for the lower part of the bundle. In the upper part of the bundle, the code predictions were below the experimental results. Most of the calculated thermo-hydraulic field variables and consequently the rod surface temperature exhibited oscillations not observed in the experiments. The early quenching predicted by the code is presumably due to overestimations in the calculated interfacial shear.

7248 **(BNL-NUREG—29861) Gas injection simulations of aspects of boiling pool flow dynamics and comparison with previous volume boiling studies.** Ginsberg, T. (Brookhaven National Lab., Upton, NY (USA)). Jul 1981. Contract AC02-76CH00016. 6p. (CONF-811103—139). NTIS, PC A02/MF A01 - GPO. File Number TI86000957.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

The objectives of this paper are to present results of a gas injection experiment and to compare results with prior gas injection and volume-heated simulation investigations.

7249 **(BNL-NUREG—36889) Improved point-kinetics model for the BWR control rod drop accident.** Neogy, P.; Wakabayashi, T.; Carew, J.F. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 6p. (CONF-851115—11). NTIS, PC A02/MF A01 - GPO. File Number TI85017839.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

A simple prescription to account for spatial feedback weighting effects in RDA (rod drop accident) point-kinetics analyses has been derived and tested. The point-kinetics feedback model is linear in the core peaking factor, F/sub Q/, and in the core average void fraction and fuel temperature. Comparison with detailed spatial kinetics analyses indicates that the improved point-kinetics model provides an accurate description of the BWR RDA.

7250 **(BNL-NUREG—36947) Probabilistic evaluation of fire protection features found in nuclear power plants.** Azarm, M.A.; Boccio, J.L.; Ruger, C. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 6p. (CONF-850610—52). NTIS, PC A02/MF A01 - GPO. File Number TI85018485.

From Annual meeting of the American Nuclear Society; Boston, MA, USA (9 Jun 1985).

This paper describes a method which can be used to evaluate, on a relative basis, the NRC Fire Protection (FP) guidelines as found in Section 9.5.1 (Fire Protection) of the Standard Review Plan (SRP). The approach, a hybrid of existing physical models for fire propagation determinations and probabilistic models for fire-mitigation system reliability, can potentially be used as an adjunct to the present fire safety review process.

7251 **(CONF-850810—8) Analysis with the 3-D COMMIX code.** (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85006836.

From National heat transfer conference; Denver, CO, USA (4 Aug 1985).

A 3-D COMMIX model was set up to simulate the 1/7-scale Westinghouse natural convection test. The COMMIX model included the upper plenum, core, lower plenum, two hot legs, and two steam generators. The pressurizer tee was modeled as an exit surface with continuous-mass-flow boundary condition. A total of 1464 computational cells and 81 surfaces were used for the COMMIX model. Three layers of vertical cells were used to model the hot leg. This model allows for reasonably accurate modeling of the countercurrent flows in the hot legs. The heat exchangers in the upper plenum and the steam generators were modeled by two-sided thermal structures. One side of the thermal structure was the hot fluid in the reactor primary system. The other side of the thermal structure was the coal fluid in the secondary system. Thermal capacity of all the structures was modeled throughout the systems according to the physical dimensions and properties of the system. The cooling coils along the outer wall of the upper plenum was modeled by a constant wall temperature of 5.5°C, which is the temperature of the water inside the cooling coils, with a heat transfer coefficient. The electric heater rod in the core region was also modeled as a thermal structure. Volume porosity and surface porosities were calculated and used in the COMMIX model throughout the computational domain to correctly simulate the structures in the experiment. Results of the COMMIX calculations based on these models were compared with the experimental measurements. The average standard deviation for the four comparisons is 2.86°C, which is reasonably good.

7252 **(CONF-851115—35) Core flood capacity: a PWR core flood tank model.** Sozer, A. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01. File Number TI86002456.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Core flood tanks, part of emergency core cooling systems, are modeled to calculate the water flow rate into the primary coolant system during transients. (DLC)

7253 **(CONF-8510173—24) Station blackout calculations for Peach Bottom.** Hodge, S.A. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01. File Number TI86003308.

From 13. water reactor safety research information meeting; Gaithersburg, MD, USA (22 Oct 1985).

A calculational procedure for the Station Blackout Severe Accident Sequence at Browns Ferry Unit One has been repeated with plant-specific application to one of the Peach Bottom Units. The only changes required in code input are with regard to the primary continment concrete, the existence of sprays in the secondary containment, and the size of the refueling bay. Combustible gas mole fractions in the secondary containment of each plant during the accident sequence are determined. It is demonstrated why the current state-of-the-art corium/concrete interaction code is inadequate for application to the study of Severe Accident Sequences in plants with the BWR MK I or MK II containment design.

7254 **(CONF-8510173—29) Station blackout calculations for Browns Ferry.** Ott, L.J.; Weber, C.F.; Hyman, C.R. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01 - GPO. File Number TI86003321.

From 13. water reactor safety research information meeting; Gaithersburg, MD, USA (22 Oct 1985).

This paper presents the results of calculations performed with the ORNL SASA code suite for the Station Blackout Severe Accident Sequence at Browns Ferry. The accident is initiated by a loss of offsite power combined with failure of all onsite emergency diesel generators to start and load. The Station Blackout is assumed to persist beyond the point of battery exhaustion (at six hours) and without DC power, cooling water could no longer be injected into the reactor vessel. Calculations are continued through the period of core degradation and melting, reactor vessel failure, and the subsequent containment failure. An estimate of the magnitude and timing of the concomitant fission product releases is also provided.

7255 **(CONF-8510223—1) Role of liability preferences in societal technology choices: results of a pilot study.** Cantor, R.; Rayner, S.; Braid, B. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003274.

From Annual meeting of the Society for Risk Analysis; Alexandria, VA, USA (6 Oct 1985).

At the 1984 Annual Meeting of the Society for Risk Analysis, Steve Rayner presented a paper that challenged the conventional wisdom of risk management research. In that paper, he argued that resolving the question, "How safe is safe enough." is less important in making societal technology choices than "How fair is safe enough?" Adopting the fairness question as the concern of risk management would imply that the process of technology choice explicitly recognize the preferred principles different parties hold with respect to obtaining consent from those affected by the risks, distributing the liabilities, and justifying trust in the relevant institutions. This paper discusses a recent empirical pilot study which explored the fairness hypothesis in the context of nuclear power. Individual interviews and focus groups were conducted to examine whether or not preferred principles for liability distributions were consistent with those suggested by the cultural characteristics of the constituency. The results suggest that for this type of societal technology choice, violation of these preferred principles may be a major source of the conflict between different constituencies. Additionally, the study contributes towards the development of a new approach in risk management that combines the cultural model of risk perceptions with the decision-theoretic approaches found in economics and psychology.

7256 **(EGG-EA—7004) Evaluation of Waterford Steam Electric Station Unit 3 technical specifications.** Baxter, D.E.; Bruske, S.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1985. Contract AC07-76ID01570. 22p. NTIS, PC A02/MF A01. File Number TI86003254.

This document was prepared for the Nuclear Regulatory Commission (NRC) to assist them in determining whether the Waterford Steam Electric Station Unit 3 Technical Specifications (T/S), which govern plant systems configurations and operations, are in conformance with the requirements of the Final Safety Analysis Report (FSAR) as amended, and the requirements of the Safety Evaluation Report (SER) as supplemented. A comparative audit of the FSAR as amended, and the SER as supplemented was performed with the Waterford T/S. Several discrepancies were identified and subsequently resolved by the cognizant NRC reviewer. Pending completion of the resolutions noted in Part 3 of this report, the Waterford Steam Electric Station Unit 3 T/S, to the extent reviewed, are in conformance with the FSAR and SER.

7257 **(EGG-M—20985) Integral Systems Test (IST) Program facility scaling and integration.** Larson, T.K. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 41p. (CONF-8510173—32). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003220.

From 13. water reactor safety research information meeting; Gaithersburg, MD, USA (22 Oct 1985).

The Integral Systems Test (IST) Program was initiated in 1982 by government and industry to help provide information needed to help resolve issues raised by the accident at the Three Mile Island nuclear power station. Three different integral test facilities, each of which is scaled to a Babcock and Wilcox (B and W) design nuclear steam supply system, will ultimately be contributing data to meet the objectives of the program. Each of the facilities was designed using different scaling methodology and has different operating capabilities such as maximum operating pressure and core power. The overall scaling of each facility is examined in this report and local scaling analyses are conducted to demonstrate potential similarities and dissimilarities in facility response relative to expected plant responses. It is shown how local thermal-hydraulic phenomena in each facility can be compared to each other or to expected plant behavior through the scaling relationships. Finally, it is shown how the global response of each facility can be related for a specific small break loss of coolant transient through the concept of an equilibrium plot. Potential complications that may arise as a consequence of the facility scaling or facility limitations are enumerated. This work was performed under the joint auspices of the Electric Power Research Institute and the US Nuclear Regulatory Commission. 14 refs., 15 figs., 5 tabs.

7258 **(EGG-M—23485) Tellurium chemistry, tellurium release and deposition during the TMI-2 accident.** Vinjamuri, K.; Sallach, R.A.; Osetek, D.J.; Hobbins, R.R.; Akers, D.W. (EG and G Idaho, Inc., Idaho Falls (USA); Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC07-76ID01570. 23p. (CONF-8510173—31). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003224.

From 13. water reactor safety research information meeting; Gaithersburg, MD, USA (22 Oct 1985).

This paper presents the chemistry and estimated behavior of tellurium during and after the accident at Three Mile Island Unit-2. The discussion of tellurium behavior is based on all available measurement data for /sup 129m/Te, ^{133}Te, stable tellurium (^{128}Te, ^{130}Te, and ^{130}Te), and best estimate calculations of tellurium release and transport. Results from Oak Ridge National Laboratory (ORNL) tests, Power Burst Facility (PBF) Severe Fuel Damage Tests at Idaho National Engineering Laboratory (INEL) and SASCHA tests from Karlsruhe, W. Germany are compared with calculated release fractions and samples taken from TMI Unit-2. It is concluded that very little tellurium was released and transported from the TMI-2 core, probably as a result of holdup by zircaloy cladding and other structural materials. 37 refs., 12 figs., 4 tabs.

7259 **(EGG-M—27385) Pipe damping.** Ware, A.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 9p. (CONF-8510173—26). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003226.

From 13. water reactor safety research information meeting; Gaithersburg, MD, USA (22 Oct 1985).

Studies are being conducted at the Idaho National Engineering Laboratory to determine whether an increase in the damping values used in seismic structural analyses of nuclear piping systems is justified. Increasing the allowable damping would allow fewer piping supports which could lead to safer, more reliable, and less costly piping systems. Test data from availble literature were examined to determine the important parameters contributing to piping system damping, and each was investigated in separate-effects tests. From the combined results a world pipe damping data bank was established and multiple regression analyses performed to assess the relative contributions of the various parameters. The program is being extended to determine damping applicable to higher frequency (33 to 100 Hz) fluid-induced loadings. The goals of the program are to establish a methodology for predicting piping system damping and to recommend revised guidelines for the damping values to be included in analyses.

7260 **(EGG-RST—7025) Capabilities of the ATHENA computer code for modeling the SP-100 space reactor concept.** Fletcher, C.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1985. Contract AC07-76ID01570. 48p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003213.

The capability to perform thermal-hydraulic analyses of an SP-100 space reactor was demonstrated using the ATHENA computer code. The preliminary General Electric SP-100 design was modeled using Athena. The model simulates the fast reactor, liquid-lithium coolant loops, and lithium-filled heat pipes of this design. Two ATHENA demonstration calculations were performed simulating accident scenarios. A mask for the SP-100 model and an interface with the Nuclear Plant Analyzer (NPA) were developed, allowing a graphic display of the calculated results on the NPA. 22 figs.

7261 (EPRI-NP—4113-SR, pp 38.1-38.13) **Interpretation of experimental results on the interactions of fission product vapors with reactor materials.** Taig, A.R.; Bowsher, B.R.; Dickinson, S.; Elrick, R.M.; Nichols, A.L.; Sallach, R.A. (UKAEA Safety and Reliability Directorate, Culcheth, England). Jul 1985. Research Reports Center, Box 50490, Palo Alto, CA 940303. File Number TI85920808. (CONF-840701—).

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Recent experimental studies are summarized on the interactions of reactor materials with specific compounds that simulate the volatile fission products cesium, iodine and tellurium. The reactions of cesium iodide, cesium hydroxide and elemental tellurium with steels and nickel alloys such as Inconel are discussed. Emphasis is placed on the retention of these fission products in light water reactor coolant systems during severe accidents. Models of fission product deposition are reviewed in terms of these data and recommendations are given for the revision of these models. Additional important features of the chemistry of cesium, tellurium and iodine have come to light in recent experiments and are summarized. The implications of fission product chemistry for reactor safety are discussed, and research needs are highlighted that will reduce the current uncertainties.

7262 **(EPRI-NP—4157) Heat transfer during quench and dryout in a vertical tube. Final report.** Seban, R.A.; Wang, S.T.; La Jeunesse, C.A.; Heydari, A. (California Univ., Berkeley (USA). Dept. of Mechanical Engineering). Jul 1985. 138p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920783.

Experimental results and the analysis thereof are reported for two kinds of experiments made with a heated vertical tube with water within it, with pressures of one to four atmospheres. In one, reflooding experiments were made with bottom introduction of water, to produce a quench front ascending the tube. Histories of the wall temperatures at a given location on the tube were used to deduce the heat flux and temperature histories on the inside wall of the tube. In the other, the tube, initially containing water, full and partially filled, was heated. After saturation conditions were attained in the water, boiling occurred, with a rapid decrease in the liquid inventory, and soon thereafter dry out began. The histories of dry out level, collapsed liquid level, and tube wall temperatures were the experimental results. Part I contains the relation of the heat flux to the difference between wall and saturation tempera-

tures in the quench region. Part II presents the results for the histories of dry out and collapsed liquid level. 8 refs., 33 figs., 9 tabs.

7263 **(GA-A—14212) Environmental temperatures in the vicinity of the rupture point of steam lines for Fort St. Vrain equipment qualification.** Del Bene, J.V. (General Atomic Co., San Diego, CA (USA)). Nov 1976. Contract AM03-76SF00167. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003777.

This report presents temperature response curves for the environment within 20 ft of a steam pipe rupture for use in equipment qualification. Worst case blowdown conditions were taken from the test and analysis report on the qualification of Fort St. Vrain safe shutdown equipment.

7264 (KFK—3880/2, pp 804-813) **Symptom based decision tree approach to boiling water reactor emergency operating procedures.** Knobel, R.C. Dec 1984. NTIS (US Sales Only), PC A99/MF A01. File Number DE86780106. (CONF-840914—Vol.2).

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

This paper describes a Decision Tree approach to development of BWR Emergency Operating Procedures for use by operators during emergencies. This approach utilizes the symptom based Emergency Procedure Guidelines approved for implementation by the USNRC. Included in the paper is a discussion of the relative merits of the event based Emergency Operating Procedures currently in use at USBWR plants. The body of the paper is devoted to a discussion of the Decision Tree Approach to Emergency Operating Procedures soon to be implemented at two United States Boiling Water Reactor plants, why this approach solves many of the problems with procedures indentified in the post accident reviews of Three Mile Island procedures, and why only now is this approach both desirable and feasible. The paper discusses how nuclear plant simulators were involved in the development of the Emergency Operating Procedure decision trees, and in the verification and validation of these procedures.

7265 (KFK—3880/2, pp 1118-1127) **Improvements to core-concrete interaction models.** Turland, B.D.; Brealey, N.J. Dec 1984. NTIS (US Sales Only), PC A99/MF A01. File Number DE86780106. (CONF-840914—Vol.2).

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

Current computer codes for the interaction of core debris with concrete concentrate of the high temperature phase of the interaction and are not designed for prediction of the long-term behaviour when conduction into the concrete becomes important. This paper describes models of various levels of complexity for thermal penetration into concrete. A simple model of thermal penetration is included in substantially improved version of the INTER code; this is compared with an alternative version which uses isotherm migration routines for conduction. A code, CONIMM, that uses fully two-dimensional isotherm migration routines and includes a simple model for water release is also described. If coupled with a 'pool' model, CONIMM would have the capability of calculating the long-term thermal penetration.

7266 **(LA-UR—85-3902) TRAC analyses for CCTF and SCTF tests and UPTF design/operation.** Spore, J.W.; Cappiello, M.W.; Dotson, P.J.; Gilbert, J.S; Martinez, V.; Stumpf, H.J. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 21p. (CONF-8510173—34). NTIS, PC A02/MF A01 - GPO. File Number TI86003687.

From 13. water reactor safety research information meeting; Gaithersburg, MD, USA (22 Oct 1985).

The analytical support in 1985 for Cylindrical Core Test Facility (CCTF), Slab Core Test Facility (SCTF), and Upper Plenum Test Facility (UPTF) tests involves the posttest analysis of 16 tests that have already been run in the CCTF and the SCTF and the pretest analysis of 3 tests to be performed in the UPTF. Posttest analysis is used to provide insight into the detailed thermal-hydraulic phenomena occurring during the refill and reflood tests performed in CCTF and SCTF. Pretest analysis is used to ensure that the test facility is operated in a manner consistent with the expected behavior of an operating full-scale plant during an accident. To obtain expected behavior of a plant during an accident, two plant loss-of-coolant-accident (LOCA) calculations were performed: a 200% cold-leg-break LOCA calculation for a 2772 MW(t) Babcock and Wilcox plant and a 200% cold-leg-break LOCA calculation for a 3315 MW(t) Westinghouse plant. Detailed results are presented for several CCTF UPI tests and the Westinghouse plant analysis.

7267 **(NUREG—0824-Suppl.1) Integrated Plant Safety Assessment Systematic Evaluation Program. Supplement No. 1. Millstone Nuclear Power Station, Unit 1 (Docket No. 50-245).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Nov 1985. 56p. NTIS, PC A04/MF A01 - GPO. File Number TI86900362.

The US Nuclear Regulatory Commission (NRC) has prepared Supplement 1 to the final Integrated Plant Safety Assessment Report (IPSAR) (NUREG-0824), under the scope of the Systematic Evaluation Program (SEP), for Northeast Nuclear Energy Company's Millstone Nuclear Power Station, Unit 1 located in Waterford, Connecticut. The SEP was initiated by the NRC to review the design of older operating nuclear power plants to reconfirm and document their safety. This report documents the review completed under the SEP for those issues that required refined engineering evaluations or the continuation of ongoing evaluations subsequent to issuing the Final IPSAR for the Millstone 1 plant. The review has provided for (1) an assessment of the significance of differences between current technical positions on selected safety issues and those that existed when Millstone 1 was licensed, (2) a basis for deciding how these differences should be resolved in an integrated plant review, and (3) a documented evaluation of plant safety. The final IPSAR and its supplement will form part of the bases for considering the conversion of the existing provisional operating license to a full-term operating license.

7268 **(NUREG—0989-Suppl.4) Safety evaluation report related to the operation of River Bend Station (Docket No. 50-458).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Sep 1985. 38p. NTIS, PC A03/MF A01 - GPO. File Number TI86900081.

Supplement No. 4 to the Safety Evaluation Report on the application filed by Gulf States Utilities Company as applicant and for itself and Cajun Electric Power Cooperative, as owners, for a license to operate River Bend Station has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is located in West Feliciana Parish, near St. Francisville, Louisiana. This supplement reports the status of certain items that had not been resolved at the time the Safety Evaluation Report and its first three supplements were published.

7269 **(NUREG—0989-Suppl.5) Safety Evaluation Report related to the operation of River Bend Station (Docket No. 50-458). Supplement No. 5.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Nov 1985. 53p. NTIS, PC A04/MF A01 - GPO. File Number TI86900331.

Supplement No. 5 to the Safety Evaluation Report on the application filed by Gulf States Utilities Company as licensee and for itself and Cajun Electric Power Cooperative, as owners, for a license to operate River Bend Station has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is located in West Feliciana Parish, near St. Francisville, Louisiana. This supplement reports the status of certain items that had not been resolved at the time the Safety Evaluation Report and its first four supplements were published.

7270 **(NUREG/CP—0017) Executive seminar on the future role of risk assessment and reliability engineering in nuclear regulation.** van Erp, J.B. (ed.). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Argonne National Lab., IL (USA)). May 1981. Contract W-31-109-ENG-38. 135p. (ANL—81-3; CONF-800166—). NTIS, PC A07/MF A01 - GPO. File Number TI86000945.

From Executive seminar on the future role of risk assessment and reliability engineering in nuclear regulation; Bethesda, MD, USA (28 Jan 1980).

This Executive Seminar was jointly sponsored by the US-NRC Office of Nuclear Regulatory Research and Argonne National Laboratory (Division of Educational Programs) for the purpose of informing NRC's staff on current thinking in the area of risk assessment and reliability engineering. Six presentations are included, along with their associated question and answer sessions.

7271 **(NUREG/CP—0018) Workshop on frameworks for developing a safety goal.** (Brookhaven National Lab., Upton, NY (USA)). Jun 1981. Contract AC02-76CH00016. 52p. (BNL-NUREG—51419; CONF-8104247—Summs.). NTIS, PC A04/MF A01 - GPO. File Number TI86000944.

From Workshop on frameworks for developing a safety goal; Palo Alto, CA, USA (1 Apr 1981).

The "Workshop on Frameworks for Developing a Safety Goal" was designed to help in pointing to directions for narrowing safety goal options for further consideration. The topics addressed included both quantitative and qualitative elements and economic, ethical, social and political issues. It was a discussion workshop, involving invited, knowledgeable persons representing a broad range of viewpoints, drawn from technical, social and humane disciplines. The general objective of the Workshop was to develop an information base on specific topics related to the formulation of a safety goal.

7272 **(NUREG/CP—0071) Transactions of the thirteenth water reactor safety research information meeting. Summaries.** Weiss, A.J. (comp.). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Oct 1985. 296p. (CONF-8510173—Summs.). NTIS, PC A13/MF A01 - GPO. File Number TI86900128.

From 13. water reactor safety research information meeting; Gaithersburg, MD, USA (22 Oct 1985).

This report contains summaries of papers on reactor safety research to be presented at the 13th Water Reactor Safety Research Information Meeting held at the National Bureau of Standards in Gaithersburg, Maryland, October 22-25, 1985. The summaries briefly describe the programs and results of nuclear safety research sponsored by the Office of Nuclear Regulatory Research, USNRC. Summaries of invited papers are also included, which cover the highlights of reactor safety research conducted by the electric utilities through the Electric Power Research Institute, the nuclear industry, and the research of government and industry in Europe and Japan. The summaries have been compiled in one report to provide a basis for meaningful discussion and information exchange during the course of the meeting, and are given in the order of their presentation in each session.

7273 **(NUREG/CR—1402) Advanced Reactor Safety Research Division quarterly progress report, October 1-December 31, 1979.** Romano, A.J. (comp.). (Brookhaven National Lab., Upton, NY (USA)). Apr 1980. Contract AC02-76CH00016. 94p. (BNL-NUREG—5117). NTIS, PC A05/MF A01 - GPO. File Number TI86002769.

Axial PGX graphite specimens from the endlength of Union Cabide log 29N6-2 were oxidized at 800°C with 0.17% H_2O + 1.7% H_2 in He. Specimens cored from the interior of the endpiece oxidized to give low density bands near the exposed surfaces. However, specimens cored from the periphery of the endpiece generally exhibited very low reactivities, and in some cases considerable, though nonhomogeneous, burnoff occurred throughout. The effect of burnoff on the strain to failure and ultimate compressive strength of EL-2 specimens appears to follow the trend expected for near-surface corrosion except at very low total burnoffs; here strain to failure and strength both appear to be significantly lower than expected. High cycle fatigue tests on Incoloy 800H and Hastelloy X in air and wet helium environments continued. For the Incoloy 800H an attempt is made to correlate fatigue strength with surface corrosion and surface hardness characteristics. In the case of Hastelloy X, prior thermal aging is found to have a significant effect on strength. There appears to ba an initial loss in strength after 2000 h aging followed by a restoration of the strenght after 3000 h. Upon prolonged aging the fatigue strength is found to decrease again. Optical and scanning electron microprobe/micro-analysis studies were carried out on fractured samples.

7274 **(NUREG/CR—1624-Vol.1) Load Combination Program. Progress report No. 5, April 1 - June 30, 1980. Volume 1.** Chou, C.K.; Lu, S.C.; Schwartz, M.W.; Dutton, J.C.; George, L.L.; Gilman, F.M.; Larder, R.A.; Streit, R.D. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1980. Contract W-7405-ENG-48. 60p. (UCID—18674-Vol.1). NTIS, PC A04/MF A01 - GPO. File Number TI85016671.

This document is a progress report on the Load Combination Program (LCP) covering the period April 1, 1980 through June 30, 1980. The report gives a general description of the program by project and tasks, together with financial summaries, technical reports generated, and meeting attendance. Two appendixes which discuss technical subjects are also included. 13 figs.

7275 **(NUREG/CR—1624-Vol.4) Load Combination Program. Progress report No. 8. Volume 4.** Chou, C.K.; Lu, S.C.; Schwartz, M.W. (Lawrence Livermore National Lab., CA (USA)). Apr 1981. Contract W-7405-ENG-48. 16p. (UCID—18674-Vol.4). NTIS, PC A02/MF A01 - GPO. File Number TI86002760.

This document reports progress on the Load Combination Program (LCP) in the period January 1 through March 31, 1981. The report describes the program by projects and tasks; it also gives financial summaries, technical reports generated, and meeting attendance.

7276 **(NUREG/CR—1821) Seismic review of the Robert E. Ginna Nuclear Power Plant as part of the Systematic Evaluation Program.** Murray, R.C.; Nelson, T.A.; Ng, D.S.; Liaw, C.Y.; Stevenson, J.D. (Lawrence Livermore National Lab., CA (USA)). 15 Nov 1980. Contract W-7405-ENG-48. 154p. (UCRL—53014). NTIS, PC A08/MF A01 - GPO. File Number TI85015927.

A limited seismic reassessment of the Robert E. Ginna Nuclear Power Plant was performed by the Lawrence Livermore National Laboratory (LLNL) for the US Nuclear Regulatory Commission (NRC) as part of the Systematic Evaluation Program. The reassessment focused generally on the reactor coolant pressure boundary and on those systems and components necessary to shut down the reactor safely and to maintain it in a safe shutdown condition following a postulated earthquake characterized by a peak horizontal ground acceleration of 0.2 g. Unlike a comprehensive design analysis, the reassessment was limited to structures and components deemed representative of generic classes. Conclusions and recommendations about the ability of selected structures and equipment to withstand the postulated earthquake are presented. 42 figs., 10 tabs.

7277 **(NUREG/CR—1864-Vol.1) Study of nonequilibrium flashing of water in a converging-diverging nozzle. Volume 1: experimental.** Abuaf, N.; Wu, B.J.C.; Zimmer, G.A.; Saha, P. (Brookhaven National Lab., Upton, NY (USA)). Jun 1981. Contract AC02-76CH00016. 167p. (BNL-NUREG—51317-Vol.1). NTIS, PC A08/MF A01 - GPO. File Number TI85015900.

A steady water loop with well controlled flow and thermodynamic conditions was designed, built, and made operational for the measurement of net vapor generation rates under nonequilibrium conditions. The test section consists of a converging-diverging nozzle with 49 pressure taps and two observation windows at the exit. Pressure distributions, photographic observations, diametrical averaged centerline void fraction distributions, detailed transverse distributions of the chordal averaged void fractions at 27 axial

locations, and area averaged void fraction distributions along the nozzle were recorded under various flashing conditions. The effects of various parameters were investigated and are reported here. The development of voids in nonequilibrium flashing flows is shown through the Oswatitsch integral to be dependent on three major factors of the void inception point which determines the initial and subsequent liquid superheats and must be accurately described; of the interfacial mass transfer rates, which depend on the local superheat and must be specified; and the local interfacial area density where the mass transfer occurs. The flashing onset correlation of Alamgir and Lienhard (1979) was extended to predict flashing inception in pipe and nozzle flows with subcooled inlet conditions. A void development model for bubbly flows ($\alpha < 0.30$) was based on a simple concept for interfacial area density in conjunction with a conduction-controlled bubble growth law. A general model of vapor generation following flashing inception was also developed. In this model, bubbly flow, bubbly-slug flow, a transitional flow comprising the annular and annular-mist regimes and finally fully dispersed droplet flow were assumed to occur at successively higher void fraction ranges. 163 figs., 23 tabs.

7278 **(NUREG/CR—1940) Developmental verification of PINSIM-MOD2.** Hagar, R.C. (Oak Ridge National Lab., TN (USA)). May 1981. Contract AC05-84OR21400. 138p. (ORNL/NUREG/TM—431). NTIS, PC A07/MF A01 - GPO. File Number TI85016012.

PINSIM-MOD2, a generalized heat conduction code for concentric cylindrical geometries, was developed at Oak Ridge National Laboratory for use in analyzing heat transfer within nuclear fuel pins and various electrically heated fuel pin simulators (FPSs). Verification of PINSIM's calculational abilities is required to support conclusions drawn from the results of PINSIM calculations. This study investigated PINSIM's ability to correctly solve inverse, forward, and backward formulations of the heat conduction problem. The PINSIM code solved an inverse formulation of the heat conduction problem by calculating the internal FPS temperatures, surface temperature, and surface heat flux, using the measured power-generation rate history and sheath thermocouple records as boundary conditions. A forward formulation calculated all internal FPS temperatures, surface temperature, and surface heat flux using the measured power-generation rate history, the coolant thermocouple record, and a surface heat transfer coefficient inferred from the results of the inverse conduction problem. A backward formulation of the conduction problem was solved by using PINSIM to calculate internal FPS temperatures and power-generation rates using calculated surface temperatures and heat flux from the inverse conduction problem as boundary conditions.

7279 **(NUREG/CR—1953) Multiple DNB events.** Nahavandi, A.N.; Fighetti, C.F.; Reddy, D.G.; Poon, T.C.L. (Brookhaven National Lab., Upton, NY (USA)). Jan 1981. Contract AC02-76CH00016. 118p. (BNL-NUREG—51345). NTIS, PC A06/MF A01 - GPO. File Number TI85016010.

The phenomenon of multiple DNB events in rod bundle heat transfer tests, referring to the occurrence of departure from nucleate boiling (DNB) on more than one heating rod or at more than one location on one heating rod, is examined. This phenomenon is characterized by the deterioration of heat transfer due to the transition from nucleate boiling to film boiling at low steam qualities or due to dryout at high steam qualities. The deterioration of heat transfer is observed by recording the temperature excursion of the heating rod thermocouples located in the region where DNB is anticipated. The available rod bundle test data at Columbia University, Heat Transfer Research Facility, are examined for multiple DNB events using a combination of parametric studies, statistical analyses and predictive correlation approach. Multiple DNB events occurring under transient test conditions, such as flow decay, have also been addressed in this report. The information needed by a subchannel computer code, such as COBRA-IIIC, for the determination of the rod bundle local conditions during flow decay tests have also been compiled. This information will further serve to ascertain the adequacy of predictive correlations based on local conditions at first DNB, for the prediction of DNB events of higher rank during transient conditions. 62 figs., 9 tabs.

7280 **(NUREG/CR—2015-Vol.1) Seismic Safety Margins Research Program. Phase I, final report - overview.** Smith, P.D.; Dong, R.G.; Bernreuter, D.L.; Bohn, M.P.; Chuang, T.Y.; Cummings, G.E.; Johnson, J.J.; Mensing, R.W.; Wells, J.E. (Lawrence Livermore National Lab., CA (USA)). 6 Mar 1981. Contract W-7405-ENG-48. 52p. (UCRL—53021-Vol.1). NTIS, PC A04/MF A01 - GPO. File Number TI85015977.

The Seismic Safety Margins Research Program (SSMRP) is a multiyear, multiphase program whose overall objective is to develop improved methods for seismic safety assessments of nuclear power plants, using a probabilistic computational procedure. The program is being carried out at the Lawrence Livermore National Laboratory and is sponsored by the US Nuclear Regulatory Commission, Office of Nuclear Regulatory Research. Phase I of the SSMRP was successfully completed in January 1981: A probabilistic computational procedure for the seismic risk assessment of nuclear power plants has been developed and demonstrated. The methodology is implemented by three computer programs: HAZARD, which assesses the seismic hazard at a given site, SMACS, which computes in-structure and subsystem seismic responses, and SEISIM, which calculates system failure probabilities and radioactive release probabilities, given (1) the response results of SMACS, (2) a set of event trees, (3) a family of fault trees, (4) a set of structural and component fragility descriptions, and (5) a curve describing the local seismic hazard. The practicality of this methodology was demonstrated by computing preliminary release probabilities for Unit 1 of the Zion Nuclear Power Plant north of Chicago, Illinois. Studies have begun aimed at quantifying the sources of uncertainty in these computations. Numerous side studies were undertaken to examine modeling alternatives, sources of error, and available analysis techniques. Extensive sets of data were amassed and evaluated as part of projects to establish seismic input parameters and to produce the fragility curves. 66 refs., 29 figs., 10 tabs.

7281 **(NUREG/CR—2319) Three-dimensional thermoelastic analysis of a Fort St. Vrain core support block.** Butler, T.A.; Anderson, C.A. (Los Alamos National Lab., NM (USA)). Sep 1981. Contract W-7405-ENG-36. 52p. (LA—9003-MS). NTIS, PC A04/MF A01 - GPO. File Number TI86000178.

A thermoelastic stress analysis of a graphite core support block in the Fort St. Vrain High-Temperature Gas-Cooled Reactor is described. The support block is subjected to thermal stresses caused by a loss of forced circulation accident of the reactor system. Two- and three-dimensional finite element models of the core support block are analyzed using the ADINAT and ADINA codes, and results are given that verify the integrity of this structural component under the given accident condition. 10 refs., 39 figs.

7282 **(NUREG/CR—2417) Identification and analysis of human errors underlying pump and valve related events reported by nuclear power plant licensees.** Speaker, D.M.; Thompson, S.R.; Luckas, W.J. Jr. (Brookhaven National Lab., Upton, NY (USA)). Feb 1982. Contract AC02-76CH00016. 29p. (BNL-NUREG—51481). NTIS, PC A03/MF A01 - GPO. File Number TI86000119.

This report provides a useful and adaptable data base of human error associated with the operation, testing, and maintenance of reactor safety system pumps and valves in licensed nulcear power plants. To produce this data base, a practical and workable methodology was developed and implemented on more than 3,000 Licensee Events Reports (LERs) which resulted in a human error data base six times larger than indicated by the LERs themselves. This data base is intended to provide a realistic assessment of the appropriate human error populations required in NUREG/CR-1880.

7283 **(NUREG/CR—3646) TRAC-PF1 independent assessment.** Knight, T.D.; Metzger, V.B. (comps.). (Los Alamos National Lab., NM (USA)). Oct 1985. Contract W-7405-ENG-36. 223p. (LA—10548-MS). NTIS, PC A10/MF A01 - GPO. File Number TI86003232.

This report documents the Los Alamos results of the second assessment phase, independent assessment for TRAC-PF1. We documented the results of the developmental assessment for TRAC-PF1 in an earlier report. This report described calculations run with the released versions of TRAC-PF1. We analyzed separate-effects tests in the Semiscale facility to investigate natural-circulation and reflux cooling. We analyzed integral tests from the Semiscale and the Loss-of-Fluid Test facilities to explore the small- and intermediate-break loss-of-coolnt-accident (LOCA) capability and the non-LOCA capability. We also analyzed the loss-of-feedwater transient in the Crystal River plant. The results show reasonably good agreement with the data, but indicate that improvements are required for the critical-flow model and the interphasic-condensation model. 38 refs., 224 figs., 19 tabs.

7284 **(NUREG/CR—3887) Human factors review for severe accident sequence analysis.** Krois, P.A.; Haas, P.M.; Manning, J.J.; Bovell, R. (Oak Ridge National Lab., TN (USA)). Nov 1985. Contract AC05-84OR21400. 224p. (ORNL/TM—9266). NTIS, PC A10/MF A01 - GPO. File Number TI86002574.

This report describes a human factors research project performed to: (1) support the Severe Accident Sequence Analysis (SASA) program and (2) develop a descriptive model of operator response in accident management. The first goal was accomplished by working with SASA analysts on the Browns Ferry Unit One anticipated transient without scram (ATWS) accident sequence to systematically assess critical operator actions and thereby demonstrate contributions to SASA analyses from human factors data and methods. The second goal was accomplished by developing a model called the Function Oriented Accident Management (FOAM) model, which provides both a conceptual structure linking off-normal safety functions with potential unconventional emergency responses and a method for developing technical guidance for those responses based on operations, engineering, and human factors data and expertise. The four components comprising the model are described and their use is shown through a table-top demonstration. 48 refs., 30 figs., 9 tabs.

7285 **(NUREG/CR—3914) Pump and valve qualification review guide.** Miller, B.E. (Brookhaven National Lab., Upton, NY (USA)). Oct 1985. Contract AC02-76CH00016. 46p. (BNL-NUREG—51807). NTIS, PC A03/MF A01 - GPO. File Number TI86002070.

This report provides NRC reviewers with guidance, assistance, and examples relating to the information and procedures to be included in an applicant's pump and valve operability assurance program, and to the scope and depth of the review. Discussed are the applicable components, concerns, methodologies, documentation, evaluation procedures, and examples of design and operability issues for pump and valve assemblies. These items should be of concern and included in an applicant's qualification program.

7286 **(NUREG/CR—3998-Vol.3) Light-water-reactor safety materials engineering research programs. Volume 3. Quarterly progress report, October-December 1984.** (Argonne National Lab., IL (USA)). Oct 1985. Contract W-31-109-ENG-38. 72p. (ANL—84-60-Vol.3). NTIS, PC A04/MF A01 - GPO. File Number TI86002992.

This progress report summarizes work performed by the Materials Science and Technology Division of Argonne National Laboratory during October, November, and December 1984 on water reactor safety problems. The research and development areas covered are Environmentally Assisted Cracking in Light-Water Reactors and Long-Term Embrittlement of Cast Duplex Stainless Steels in Light-Water-Reactor Systems.

7287 **(NUREG/CR—4133) Nuclear power safety reporting system. Implementation and operational specifications.** Newton, R.D.; Ims, J.R.; Finlayson, F.C. (Aerospace Corp., El Segundo, CA (USA)). Nov 1985. 115p. (ATR—85(5818)2). NTIS, PC A06/MF A01 - GPO. File Number TI86900344.

This document presents the results of a study conducted by the US Nuclear Regulatory Commission of a voluntary, third-party managed, nonpunitive data gathering system (the Nuclear Power Safety Reporting System - NPSRS). The data to be gathered by the NPSRS are intended for use in identifying and quantifying the factors that contribute to the occurrence of significant safety problems involving humans in nuclear power plants. The NPSRS has been designed to encourage participation in the system through guarantees of reporter anonymity provided by a third party organization that is responsible for management of the system. This document presents the specifications for implementation and day-to-day operations of the NPSRS. In it, the elements, requirements and procedures of the system are outlined.

7288 **(NUREG/CR—4209) Comparison of analytical predictions and experimental results for a 1:8-scale steel containment model pressurized to failure.** Clauss, D.B. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1985. Contract AC04-76DP00789. 63p. (SAND—85-0679). NTIS, PC E04/MF A01 - GPO. File Number TI86003552.

Predictions for the response of a 1:8-scale model of a steel nuclear containment building to overpressurization are compared to experimental results. Finite element analyses were used to predict the model's response. Strains, displacements, and leak rate measurements were made at 21 different pressure levels. Comparisons of the pressure histories for strain and displacement at a point, and the spatial variation of strain and displacement are made. In addition, comparisons of a more global nature, such as the capacity of the model and the failure mode, are discussed. An evaluation of the predictive capabilities and the failure criteria is made in light of these comparisons.

7289 **(NUREG/CR—4350/5) Probabilistic risk assessment course documentation. Volume 5. System reliability and analysis techniques Session D - quantification.** Lofgren, E.V. (Science Applications International Corp., McLean, VA (USA)). Aug 1985. Contract AC04-76DP00789. 205p. (SAND—85-1495/5). NTIS, PC A10/MF A01 - GPO. File Number TI86003269.

This course in System Reliability and Analysis Techniques focuses on the probabilistic quantification of accident sequences and the link between accident sequences and consequences. Other sessions in this series focus on the quantification of system reliability and the development of event trees and fault trees. This course takes the viewpoint that event tree sequences or combinations of system failures and success are available and that Boolean equations for system fault trees have been developed and are available. 93 figs., 11 tabs.

7290 **(NUREG/CR—4385) Effects of control system failures on transients, accidents and core-melt frequences at a Westinghouse PWR.** Bickford, W.E.; Tabatabai, A.S. (Pacific Northwest Labs., Richland, WA (USA)). Nov 1985. Contract AC06-76RL01830. 93p. (PNL—5543). NTIS, PC A05/MF A01 - GPO. File Number TI86003761.

Pacific Northwest Laboratory (PNL) performed a probabilistic risk assessment to develop estimates of core-melt frequency and public risk due to control system failures in a Westinghouse pressurized water reactor. Value/impact analyses of proposed systems modifications to prevent the control system failures were also performed. Four control system failure modes were analyzed: (1) overfill; (2) overcool; (3) overpressure; and (4) steam generator tube rupture. For each mode, two failure sequences were postulated. These analyses were based on the results of failure modes and effects analyses previously performed at Idaho National Engineering Laboratory and conducted in support of the US Nuclear Regulatory Commission's program for Unresolved Safety Issue A-47: Safety Implications of Control Systems. 15 refs., 22 tabs.

7291 **(NUREG/CR—4399) Possible options for reducing occupational dose from the TMI-2 basement.** Munson, L.F.; Harty, R. (Pacific Northwest Labs., Richland, WA (USA)). Nov 1985. Contract AC06-76RL01830. 119p. (PNL—5557). NTIS, PC A06/MF A01 - GPO. File Number TI86003775.

The major sources of exposure in the basement include the enclosed stairwell/elevator shaft structure, water and sludge in the elevator shaft, cast concrete walls, concrete floor slab, water and sludge on the floor, and activity in the paint and loose surface con-

tamination. The sources were identified using data obtained by the utility from water processing, water and solid samples, remote video inspections and radiation monitoring with a robot, and strings of thermoluminescent dosimeters lowered from upper elevations. The area dose rates in the basement range from approximately 4 R/hr (in the NE quadrant) to over 1100 R/hr (near the enclosed stairwell/elevator shaft structure). It is estimated that the basement contains between 11,000 and 21,000 curies of ^{137}Cs. Specific decontamination and cleanup techniques are discussed. These techniques include flushing with water, high-pressure water blasting, leaching, scabbling and chemical cleaning. The applicability of these techniques to the major sources of radiation are discussed, and possible approaches and work sequences for basement cleanup are given.

7292 **(NUREG/CR—4402-Vol.1) High-temperature gas-cooled reactor safety studies for the Division of Accident Evaluation quarterly progress report, January 1-March 31, 1985.** Ball, S.J.; Cleveland, J.C.; Harrington, R.M.; Weber, C.F.; Wilson, J.H. (Oak Ridge National Lab., TN (USA)). Oct 1985. Contract AC05-84OR21400. 14p. (ORNL/TM—9798/Vol.1). NTIS, PC A02/MF A01 - GPO. File Number TI86001938.

Modeling, code development, and analyses of the modular High-Temperature Gas-Cooled Reactor (HTGR) continued with work on the side-by-side design. Fission-product release and transport experiments were completed. A description and assessment report on Oak Ridge National Laboratory HTGR safety codes was issued.

7293 **(NUREG/CR—4429) TRAC-BD1/MOD1 user's guideline.** Hanson, R.G. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1985. Contract AC07-76ID01570. 98p. (EGG—2423). NTIS, PC A05/MF A01 - GPO. File Number TI86003737.

Code assessment studies and specific code applications have provided insight into the effective use of the TRAC-BWR series of codes. This document reports the experience gained from the studies and serves to assist the user in the effective application of the TRAC-BD1/MOD1 computer code. This document stresses the user's perspective relative to approprite use of the TRAC-BD1/MOD1 code and is considered an adjunct to other documentation provided with the code.

7294 **(NUREG/TR—0027) Availability of a periodically tested standby system.** Signoret, J.P. (Nuclear Regulatory Commission, Washington, DC (USA)). Mar 1978. 49p. NTIS, PC A03/MF A01 - GPO. File Number TI86900077.

This paper calculates the scheduled instantaneous and steadyy-state availability of periodically tested standby systems. The first part concerns the simple case of a material considered as a single component. Formulas are established on the basis of characteristic reliability parameters. The second part concerns complex systems, such as "series systems" and "parallel systems." Subsequent analytical formulas are established which require computer calculation. The previous formulas evaluate the scheduled instantaneous availability in terms of the time (transient period and the steady state which is reached after a time). A calculation gives directly the steady state value. The first aim of this study is assessment of nuclear safeguard systems availability but the results obtained may be applied to any industrial standby system which is periodically tested to reveal the failures that have occurred during its waiting period.

7295 **(PNL-SA—9612) RIA testing of PCI resistant fuel.** Hoshi, T.; Ishikawa, M.; Noble, L.D.; Rowland, T.C.; Courtright, E.L. (Pacific Northwest Labs., Richland, WA (USA)). Aug 1981. Contract AC06-76RL01830. 12p. (CONF-810803—14). NTIS, PC A02/MF A01 - GPO. File Number TI85016705.

From Topical meeting on reactor safety aspects of fuel behavior; Sun Valley, ID, USA (2 Aug 1981).

Advanced fuel designs resistant to the pellet-clad-interactions (PCI) failure mechanism are being developed by General Electric through a United States Department of Energy-Commonwealth Edison Company, sponsored program. Two concepts are investigated in the program: Zircaloy cladding with zirconium linear on the inner surface, and Zircaloy cladding with a copper plated inner surface. The performance of both of those "barrier-clad" concepts in reactivity initiated accidents (RIA) was investigated at the Nuclear Safety Research Reactor (NSRR) in Japan through cooperation with the United States Nuclear Regulatory Commission and the Japanese Atomic Energy Research Institute. For a boiling water reactor (BWR) the most severe RIA is a hypothetical case in which an inserted control rod becomes decoupled from the drive mechanism. It is postulated that the control drive is then withdrawn, but the control rod remains in reactor, to drop out suddenly at some later time. Analysis indicates the severest transients occur during ambient or hot standby conditions. RIA simulation transients from ambient conditions were performed at the NSRR. In these experiments, the energy deposition to the fuel rods was in the range of 150 to 400 cal/g.UO_2. Fuel failure behavior and failure thresholds were determined for both barrier fuels and reference fuel rods. 10 figs.

7296 **(PNL-SA—12814) COBRA/TRAC simulation of the Semiscale S-UT-5 SBLOCA.** Bian, S.H.; Thurgood, M.J. (Pacific Northwest Labs., Richland, WA (USA); Numerical Applications, Inc., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 6p. (CONF-850610—49). NTIS, PC A02/MF A01 - GPO. File Number TI85017897.

From Annual meeting of the American Nuclear Society; Boston, MA, USA (9 Jun 1985).

The purpose of the COBRA/TRAC simulation of Semiscale Test S-UT-5 is to study the capability of COBRA/TRAC to predict the system response in a 2.5% small-break LOCA (SBLOCA) and the effects of upper head injection (UHI) on core behavior. In addition, it serves to verify the capability of the code to simulate the integrated configuration of a PWR. The COBRA/TRAC code uses a set of compressible three-dimensional, two-fluid, three-field equations to represent two-phase flow in the reactor vessel and steam generators. The three fields are the vapor field, the continuous liquid field, and the liquid drop field. A five-equation drift flux model is used to model fluid flow in the primary system piping, pressurizer, pumps, and accumulators. The heat generation rate of the core is specified by input and no reactor kinetics calculations are included in the solution.

7297 **(PNL-SA—13061) Characterization of residual radionuclide contamination within and around commercial nuclear power plants.** Robertson, D.E.; Abel, K.H.; Thomas, C.W.; Lepel, E.A.; Evans, J.C.; Thomas, W.V.; Carrick, L.C.; Leale, M.W. (Pacific Northwest Labs., Richland, WA (USA)). Jul 1985. Contract AC06-76RL01830. 34p. (CONF-850720—5). NTIS, PC A03/MF A01 - GPO. File Number TI85016610.

From International nuclear reactor decommissioning planning conference; Bethesda, MD, USA (16 Jul 1985).

To provide a statistically valid data base for the residual radionuclide inventories in nuclear power stations, Pacific Northwest Laboratory (PNL) was contracted to conduct an extensive sampling and measurements program at a number of nuclear power plants. This paper summarizes the results of the radionuclide characterization studies conducted at seven nuclear power stations from a decommissioning assessment viewpoint.

7298 **(PNL-SA—13505) Use of accident experience in developing criteria for teleoperator equipment.** Vallario, E.J.; Selby, J.M. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 21p. (CONF-8506148—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86004030.

From Workshop on requirements of mobile teleoperators for radiological emergency response and recovery; Dallas, TX, USA (23 Jun 1985).

The 1961 SL-1 reactor accident in Idaho and the Recuplex accident at Hanford are reviewed to identify problems common to emergency situations, lessons learned from accidents, criteria for emergency equipment, and recommendations for using robotics to solve problems during emergencies. Teleoperator equipment could be used to assess the extent of the damage and the condition of the reactor, retrieve dosimeters, evacuate and treat accident victims, clean up debris and decontaminate accident areas. 2 refs., 9 figs.

7299 **(SAND—85-1848C) Experimental validation and improvement of core debris/concrete interaction models.** Suo-Anttila, A.J.; Gronager, J.E.; Blose, R.E.; Bradley, D.R. (Science Applications International Corp., Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA); Ktech Corp., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 18p. (CONF-8510173—9). NTIS, PC A02/MF A01 - GPO. File Number TI86002122.

From 13. water reactor safety research information meeting; Gaithersburg, MD, USA (22 Oct 1985).

Molten core-concrete interactions are an important aspect of radioactive source-term evaluations in severe nuclear reactor accidents. At Sandia National Laboratories (SNL) six melt concrete interaction experiments have recently been conducted. An analysis of these experiments by the CORCON code has indicated discrepancies between the experimental data and the predictions. An alternate model with different heat and mass transfer phenomenology has been able to successfully predict the experimental data. The results of the alternate model suggest that the CORCON code should be modified to encompass other heat and mass transfer regimes previously thought not to exist in melt-concrete interactions. 9 refs., 22 figs., 1 tab.

7300 **(SAND—85-2026C) MELPROG: an integrated model for in-vessel melt progression analysis.** Kelly, J.E. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 15p. (CONF-8510173—7). NTIS, PC A02/MF A01 - GPO. File Number TI86001753.

From 13. water reactor safety research information meeting; Gaithersburg, MD, USA (22 Oct 1985).

The current emphasis on understanding severe accidents in light water reactors has led to the development of detailed systems models. These models are intended to analyze the response of the reactor core and vessel, the reactor coolant system, and the reactor containment. In this paper, one such core and vessel response code, MELPROG, is described. The purpose of MELPROG is to calculate the state of the reactor core and in-vessel environment and the disposition of core materials within the reactor coolant system boundary during a severe accident sequence. MELPROG uses mechanistic modeling of the important physical processes and treats the coupling between various phenomena. The physical processes are logically grouped together to form a module code structure. The first version of MELPROG has been completed and is being tested. A TMLB' accident sequence calculation for the Surry reactor is also presented in this paper. This calculation clearly demonstrates the advanced analysis capabilities of MELPROG. 6 refs., 5 figs.

7301 **(SAND—85-2084C) Models for BWR and PWR engineered safety features in the CONTAIN code.** Schelling, F.J.; Williams, D.C.; Murata, K.K.; Rexroth, P.E. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 13p. (CONF-8510173—12). NTIS, PC A02/MF A01 - GPO. File Number TI86002127.

From 13. water reactor safety research information meeting; Gaithersburg, MD, USA (22 Oct 1985).

A fairly extensive and flexible set of engineered safety features is available in the CONTAIN code for modeling their effects on containment conditions during the course of reactor accidents. Features of the models for containment spray fan-cooler, ice condenser, and liquid flow network systems are discussed, as is the developmental model for a BWR suppression pool. These models permit the mechanistic treatment of a number of interrelated physical phenomena, including thermal-hydraulic, aerosol, and fission product behavior. Recent results obtained in a study of the TMLB' sequence with spray recovery for the Surry plant are presented, which exemplify this capability. The main conclusion of this study is that an integrated analysis of relevant physical phenomena is necessary to explain enhanced aerosol decontamination effects for sprays under hydrogen burn conditions. 8 refs., 4 figs.

7302 **(SSI—85-04) Collective doses from recycling of contaminated scrap metal.** Bergman, C.; Boge, R. (National Inst. of Radiation Protection, Stockholm (Sweden)). Jan 1985. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86700226.

Collective doses have been calculated for the recycling of 90 tons of contaminated scrap metal from a nuclear power plant. The contamination level was of the order of 100 Bq/kg and the resulting collective doses from handling, transportation, and melting was calculated to 70 μmanSv. The doses from the use of the products manufactured from this batch were negligible although they were not calculated.

7303 **(TFBP-TR—262) Power-Cooling Mismatch Test series. Test PCM-1, Quick Look Report.** Domenico, W.F.; Stanley, C.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1978. Contract AC07-76ID01570. 40p. NTIS, PC A03/MF A01 - GPO. File Number TI85016659.

The Power-Cooling-Mismatch (PCM) Test, PCM-1 was conducted on March 30, 1978 in the Power Burst Facility at the Idaho National Engineering Laboratory. The test was the eighth test in the series of PCM tests designed to characterize the behavior of nuclear fuel rods operating under various combinations of lower than normal coolant flow and higher than normal rod power. The PCM-1 test consisted of a single PWR designed fuel rod containing a 0.91 m long stack of unirradiated UO_2 fuel pellets. The objective of the test was to simulate a severe PCM incident leading to fuel rod failure at power with sufficient molten fuel present within the rod to produce a high probability of molten fuel-coolant interaction (MFCI) when failure occurred. 14 figs.

7304 **(UCRL—84181) Fracture mechanicsl evaluation of reactor piping reliability I: model description.** Harris, D.O.; Lim, E.Y.; Dedhia, D.; Streit, R.D. (Lawrence Livermore National Lab., CA (USA); Science Applications, Inc., Palo Alto, CA (USA)). Jan 1981. Contract W-7405-ENG-48. 12p. (CONF-810801—28). NTIS, PC A02/MF A01 - GPO. File Number TI85016686.

From 6. international conference on structural mechanics in reactor technology; Paris, France (17 Aug 1981).

Safety-related structures, systems, and components in commercial nuclear power plants are designed to withstand the combined effects of an earthquake and a large loss-of-coolant accident (LOCA). The combination of the most severe LOCA load with safe shutdown earthquake (SSE) loads was not controversial until about five years ago when the postulated LOCA and SSE loads were both increased due to improved analysis techniques and to account for such phenomena as asymmetric blowdown in pressurized water reactor (PWR) nuclear power plants. The combination requirement has therefore become more difficult to implement, particularly in the design of reactor pressure vessel internal and support systems. As a result, the US Nuclear Regulatory Commission (USNRC) has initiated programs to establish a technical basis for reassessing the load combination design requirement. The objective of this study is to estimate the probability of the simultaneous occurrence of a double-ended guillotine break in the primary loop piping system and an earthquake. A summary report of the large-LOCA-earthquake event combination probability assessment is given by Lu, Streit, and Chou. In this paper the model used for estimating the reliability of piping in nuclear power reactors is presented.

7305 **(UCRL—84182) Comparison of linear-elastic-plastic, elastic-plastic, and fully plastic failure models in the assessment of piping integrity.** Streit, R.D. (Lawrence Livermore National Lab., CA (USA)). Jan 1981. Contract W-7405-ENG-48. 12p. (CONF-810801—30). NTIS, PC A02/MF A01 - GPO. File Number TI85016685.

From 6. international conference on structural mechanics in reactor technology; Paris, France (17 Aug 1981).

A double-ended guillotine break in the primary coolant loop of a pressurized water reactor (PWR) is a postulated loss of coolant accient which can result in extreme dynamic loads (i.e., the asymmetric blowdown load) on the reactor pressure vessel (RPV) an vessel intervals. Design and construction of the RPV and support systems to withstand these extreme dynamic loads is very difficult. Similar high loading would also be experienced in a boiling water reactor given a similar accident. Although such a break would be an extremely rare event, its obvious safety and design implications demand that it is carefully evaluated. The work discussed here is part of the Load Combinations Program at Lawrence Livermore

National Laboratory to estimate the probability of a double-ended guillotine break in the primary reactor coolant loop of a selected PWR. The program employs a fracture mechanics based fatigue model to propagate cracks from an initial flaw distribution. It was found that while most of the large cracks grew into leaks, a complete (or nearly complete) circumferential crack could lead to a double-ended pipe break with prior leaking and thus, without warning. It is important to assess under what loads such a crack will result in complete pipe severance. The loads considered in this evaluation result from pressure, dead weight and seismic stresses. For the PWR hot leg considered in this investigation the internal pressure contributes the most to the load controlled stresses (i.e., stresses which can cause piping failure) and thus, the problem is treated as axisymmetric with uniform axial loading.

7306 **(UCRL—84186) Probabilistic assessment of decoupling loss-of-coolant accident and earthquake in nuclear power plant design.** Lu, S.C.; Harris, D.O. (Lawrence Livermore National Lab., CA (USA); Science Applications, Inc., Palo Alto, CA (USA)). Jan 1981. Contract W-7405-ENG-48. 9p. (CONF-810801—25). NTIS, PC A02/MF A01 - GPO. File Number TI85016681.

From 6. international conference on structural mechanics in reactor technology; Paris, France (17 Aug 1981).

This paper describes a research project conducted at Lawrence Livermore National Laboratory to establish a technical basis for reassessing the requirement of combining large loss-of-coolant-accident (LOCA) and earthquake loads in nuclear power plant design. A large LOCA is defined herein as a double-ended guillotine break of the primary reactor coolant loop piping (the hot leg, cold leg, and crossover) of a pressureized water reactor (PWR). A systematic probability approach has been employed to estimate the probability of a large LOCA directly and indirectly induced by earthquakes. The probability of a LOCA directly induced by earthquakes was assessed by a numerical simulation of pipe rupture of a reactor coolant system. The simulation employed a deterministic fracture mechanics model which dictates the fatigue growth of preexisting cracks in the pipe. The simulation accounts for the stochastic nature of input elements such as the initial crack size distribution, the crack occurrence rate, crack and leak detection probabilities as functions of crack size, plant transient occurrence rates, the seismic hazard, stress histories, and crack growth model parameters. Effects on final results due to variation an uncertainty of input elements were assessed by a limited sensitivity study. Results of the simulation indicate that the probability of a double-ended guillotine break, either with or without an earthquake, is very small (on the orer of 10^{-12}). The probability of a leak was found to be several orders of magnitudes greater than that of a complete break.

7307 **(UCRL—84187) Load combination research program at the Lawrence Livermore National Laboratory.** Chou, C.K. (Lawrence Livermore National Lab., CA (USA)). Jan 1981. Contract W-7405-ENG-48. 7p. (CONF-810801—27). NTIS, PC A02/MF A01 - GPO. File Number TI85016680.

From 6. international conference on structural mechanics in reactor technology; Paris, France (17 Aug 1981).

The first phase of the Load Combination Program started March, 1979 and was completed at the end of the summer of 1980. The following objectives were addressed relating to two major issues: estimate the probability of a large LOCA induced by earthquakes for a selected PWR plant and develop a probabilistic fracture mechanics model that can be used to estimate piping reliability in general; and develop a methodology for combining generic dynamic loads for nuclear power plant design.

7308 **(YJT—85-05) Decommissioning optimization of the Loviisa nuclear power station; dismantling the pressure vessel and decontamination of primary circuit.** Vaelimaeki, P. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Mar 1985. 83p. NTIS (US Sales Only), PC A05/MF A01. File Number DE86700224.

The report describes radioactivities and radiation levels in decommissioning situation at the Loviisa Nuclear Power Station and optimization of plant decommissioning in view of costs and radiation doses. In calculation of the activity inventory, the existing activity calculations, the literature data and the measuring results and experiences gained at the Loviisa plant have been used as basic data. The radiation levels have been calculated with a computer program based on the point kernel method. A technique for dismantling the reactor pressure vessel and internals as large parts has been developed. As compared with segmenting into small parts, the developed dismantling technique saves FIM 12.3 million of immediate costs and 0.7 manSv of collective radiation doses, if the plant is decommissioned two years after the final reactor shutdown. Savings in total decommissioning costs and doses is 3-4%. Costs of primary circuit chemical decontamination of one plant unit are FIM 1.7 million. Major part of the costs is caused by solidification and final disposal of active waste produced in decontamination. The primary circuit decontamination saves 0.36 manSv in collective radiation doses caused by dismantling operations, if the plant is decommissioned two years after the final reactor shutdown. Price of a saved manSv is FIM 4.8 million.

7309 **(EPRI-NP—2511-CCM-Vol.1-Rev.2) VIPRE-01: a thermal-hydraulic code for reactor cores. Volume 1: mathematical modeling (Revision 2).** Stewart, C.W.; Cuta, J.M.; Montgomery, S.D.; Kelly, J.M.; Basehore, K.L.; George, T.L.; Rowe, D.S. (Pacific Northwest Labs., Richland, WA (USA)). Jul 1985. 176p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85016258.

Enclosed are revisions to the VIPRE code documents for Volume 1. These provisions conform to the changes made to VIPRE-01, CYCLE-00 to produce the new version of the code denoted by VIPRE-01, CYCLE-01. The first pages of the revisions specify where the replacement pages are to be inserted and which pages of the original documents should be retained. If you would like to obtain the original report and Revision 1, please contact Research Reports Center. 40 figs., 13 tabs.

7310 **Assessment of TRAC codes with dartmouth college countercurrent flow tests.** Rohatgi, U.S. (Brookhaven National Laboratory, Department of Nuclear Energy, Upton, New York). *Nuclear Technology;* 69: No. 1, 100-106(Apr 1985).

The TRAC series of codes was developed to simulate pressurized water reactors (PWRs) and boiling water reactors (BWRs) under hypothetical accident conditions. The thermal hydraulics of these codes are based on a two-fluid formulation. These codes were applied to the Dartmouth College countercurrent flow tests to assess the ability of the interfacial momentum transfer models in the code to predict the countercurrent behavior. The TRAC-BD1 code, developed for the BWR analysis, qualitatively predicted the proper countercurrent flow behavior, but always overpredicted the liquid downflow. This led to the conclusion that interfacial momentum transfer in the annular regime was underestimated. The PWR version of the TRAC code, TRAC-PF1, had better agreement with the data but computed unusual behavior for the 0.152-m-i.d. pipe due to the use of Dukler's correlation outside the data base. The code prediction improved when Bharathan-Wallis' correlation was incorporated into this code. The correlations based on cocurrent data were not accurate in predicting countercurrent flows.

7311 **A coordinated approach to nuclear power plant design.** Winblad, A.E.; Olascoaga, M.T. (Sandia National Laboratories Albuquerque, NM). *Nuclear Materials Management;* 13: 207-211(Jul 1984). (CONF-840734—).

From 25. annual meeting of the Institute of Nuclear Materials Management; Columbus, OH, USA (15 Jul 1984).

An approach to the design of a nuclear power plant that coordinates operations, safety, and security requirements is presented. A number of steps in the approach are identified. Construction features, equipment, and procedural elements that must be considered in a coordinated, standardized design are identified. An example of a design concept that meets some of these requirements is described.

7312 **(CE-Trans—8053) Results of studies of the thermohydraulics of primary pumps in PWR reactors.** Grison, P.; Lauro, J.F. Translated from *Houille Blanche ;* No. 7/8, 655-663(1982). 25p. NTIS, PC A02/MF A01. File Number DE85901896.

The development of pressurized water nuclear reactors imposes very strict standards in order to ensure power station safety. The entire primary circuit is thus designed to withstand the consequences of a serious accident, such as a loss of primary coolant accident (LOCA) by the opening of a breach in the circuit. The safety analysis, which is carried out in order to study such accidents, shows that the determining factors are: the maximum temperature in the cladding; the excess pressure in the containment; and the stresses imposed on the equipment. Also, the various parametric studies carried out shows that the behavior of the pump plays an essential part in determining these factors. In fact the pump either: has the function of a flow limiter when it is on the ruptured leg; or determines the distribution of the flows in the core when it is on the intact leg. An evaluation of the safety margins available on these reactors therefore requires a good knowledge of the behavior of the pump in accident situations with a change to two-phase operation. It is for this purpose that EDF launched the EPOPEE (Primary Pump Tests in a Water-Steam Emulsion) research programme on this subject in 1976. An experimental campaign, as well as a theoretical analysis, thus culminated in 1981 in the modelling of the pump in an accident situation. A summary of this study is given. 22 refs., 15 figs., 12 tabs.

7313 **(CE-Trans—7615) Problem of sea water intakes and outfalls for large nuclear power stations.** Bellin, A.; Vannetzel, P. Translated from *Houille Blanche ;* No. 7, 8, 501-508(1975). 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85902081.

While nuclear energy still has to be converted to electricity via mechanical energy, it will be difficult to get away from the Carnot principle: the heat sink and the cooling water systems will therefore remain a major element of power stations, requiring considerable attention on the part of engineers. The terms "heat sink" and "cooling water system" are very general even when confined solely to coastal power stations. In this paper, we do not intend to go into these subjects in detail but will be seeking rather to outline the basic characteristics are described, and certain basic types are identified from the vast range of variations necessitated by different land and sea conditions. Topics discussed include: the future of coastal power stations; the main features of heat sinks depending on the type of site and the intake and outfall works; the different types of site and associated cooling water systems; and different types of intake and outfall systems. 9 figs.

25 ENERGY STORAGE

7314 **(CONF-850103—13) Energy storage options for space power.** Hoffman, H.W.; Martin, J.F.; Olszewski, M. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003307.

From 2. symposium on space nuclear power systems; Albuquerque, NM, USA (14 Jan 1985).

Including energy storage in a space power supply enhances the feasibility of using thermal power cycles (Rankine or Brayton) and providing high-power pulses. Review of storage options (superconducting magnets, capacitors, electrochemical batteries, thermal phase-change materials (PCM), and flywheels) suggests that flywheels and phase-change devices hold the most promise. Latent heat storage using inorganic salts and metallic eutectics offers thermal energy storage densities of 1500 to 2000 kJ/kg at temperatures to 1675°K. Innovative techniques allow these media to operate in direct contact with the heat engine working fluid. Enhancing thermal conductivity and/or modifying PCM crystallization habit provide other options. Flywheels of low-strain graphite and Kevlar fibers have achieved mechanical energy storage densities of 300 kJ/kg. With high-strain graphite fibers, storage densities appropriate to space power needs (~ 550 kJ/kg) seem feasible. Coupling advanced flywheels with emerging high power density homopolar generators and compulsators could result in electric pulse-power storage modules of significantly higher energy density.

2501 MAGNETIC

7315 **Operation of the 30 MJ superconducting magnetic energy storage system in the Bonneville Power Administration electrical grid.** Rogers, J.D.; Boenig, H.J.; Schermer, R.I. (Los Alamos National Laboratory, Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **MAG 21**: No. 2, 752-755(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

The 30 MJ superconducting magnetic energy storage (SMES) system was installed in the Bonneville Power Administration (BPA) Tacoma Substation in 1982-83. Operation of the unit since that time has been for over 1200 hours. Specific tests to explore the SMES system's thermal and electrical characteristics and the control functions were conducted. The coil heat load with current modulation was determined. A converter with two 6-pulse bridges interfaces the superconducting coil to the power bus. Equal bridge voltage amplitude and constant reactive power modes of operation of the system were run with computer control of the SCR bridge firing angles. Coil energy dump tests were performed. Electrical grid system response to SMES modulation was observed, and full power SMES modulation was undertaken.

7316 **Commissioning tests of the bonneville power administration 30 MJ Superconducting Magnetic Energy Storage unit.** Boenig, M.J.; Hauer, J.F. (Los Alamos National Laboratory, Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems;* **PAS-104**: No. 2, 302-312(Feb 1985).

A 30 MJ (8.4 kWh) Superconducting Magnetic Energy Storage (SMES) unit with a 10 MW converter has been installed and commissioned at the Bonneville Power Administration (BPA) substation in Tacoma, Washington. This is the first large-scale application in the US of superconductivity in an electric utility system. The unit, which is capable of absorbing and releasing up to 10 MJ of energy at a frequency of 0.35 Hz, was designed to damp the dominant power swing mode of the Pacific AC Intertie. This paper describes the electrical characteristics of the magnetic energy storage unit, its modes of operation, results of device tests, means for controlling real and reactive power, and some initial power system response tests. A short summary of the operating history of the unit over the first eleven months is also presented.

2506 THERMAL

REFER ALSO TO CITATION(S) 7139, 7177, 7409, 7410, 7411, 7412, 7413, 7415

7317 **(Juel-Spez—297) Latent heat stores - technology and applications.** Lottner, V. (ed.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Energieforschung). Feb 1985. 315p. (CONF-8403146—). NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490.

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

Five sessions of this workshop cover state-of-the-art, latent heat stores for solar energy, residential applications for heating and cooling, commerical heating and cooling, and industrial and utility applications. The sixth session concerns chairman's reports and recommendations. 25 contributed papers have been indexed separately for the data base.

7318 (Juel-Spez—297, pp 11-23) **Some materials and measures to store latent heat.** Schroeder, J. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

Salt hydrates and salt hydrate-water eutectics previously selected as being suitable for storing latent heat have been subjected to a more detailed investigation. Relevant data of investigated ma-

terials are given and some measures necessary for reliable operation in storage units are described.

7319 (Juel-Spez—297, pp 39-43) **Industrial work on latent heat storage.** Kando, P.F. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—). Contract AC05-84OR21400.

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

This paper is a presentation of the state-of-the-art in commercially-available thermal storage products using phase change materials (PCMs) in the United States. After presenting a brief overview of the U.S. building market and establishing the need for thermal storage, the presentation discusses needs for future development of PCM products.

7320 (Juel-Spez—297, pp 44-58) **Identifications of thermal energy storage opportunities in industrial processes.** Melikian, G.; McChesney, H.R.; Obee, T.N. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

Detailed evaluation of TES opportunities in a variety of industrial processes has been conducted as an extension of a multi-year, ongoing EPRI-funded program to assist member utilities in identifying and evaluating industrial process energy conservation and management (EC and M) opportunities for their customers. Specifically, plant audits were conducted in twenty-two (22) different industries in cooperation with seven (7) U.S. utilities. Over thirty-three (33) EC and M applications were identified for which alternative EC and M technologies were designed and economically ranked. The procedure employed and typical results of these evaluations are presented. In addition, the computerized industrial EC and M design and assessment model utilized in this program and the procedures used to identify and assess TES opportunities are described.

7321 (Juel-Spez—297, pp 139-146) **Latent heat storage in cooling systems.** Tomlinson, J.J. (Oak Ridge National Lab., TN (USA). Engineering Technology Div.). Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—). Contract AC05-84OR21400.

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

In building space conditioning applications where cooling is a major component, thermal energy storage can be used to shift the electrical cooling load imposed on a utility during peak cooling loads and small buildings located in summer peaking utility service areas are particularly attractive for application of this technology. Ice is the latent heat storage material most commonly used as the thermal storage medium for building cooling; however, new materials including clathrates, salt hydrates, and liquid-liquid systems are being explored. This paper discusses cool storage applications and provides an overview of research underway to develop these new latent heat materials.

7322 (Juel-Spez—297, pp 289-296) **Advanced latent heat storage media for high-temperature industrial applications.** Olszewski, M. (Oak Ridge National Lab., TN (USA). Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—). Contract AC05-84OR21400.

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

Several advanced thermal energy storage (TES) media are being developed for high-temperature industrial applications as part of the Oak Ridge National Laboratory (ORNL) TES Program. One of these concepts involves a composite medium consisting of a phase-change carbonate salt supported and immobilized within a submicron-sized capillary structure of a particulate ceramic matrix or porous sintered ceramic. Immobilization of the molten salt within the ceramic structure permits operation of the composite pellets, bricks, or other shapes in direct contact with compatible fluids. Energy storage occurs in both sensible and latent forms with the composite providing higher energy storage densities than standard sensible heat storage systems. This paper describes the concept and provides information concerning current development activities.

2508 CHEMICAL

REFER ALSO TO CITATION(S) 7177

7323 **(DOE/ER/04178—9) Photochemical energy storage: studies of inorganic photoassistance agents. Progress report, October 1, 1984-September 30, 1985.** Wrighton, M.S. (Massachusetts Inst. of Tech., Cambridge (USA)). 1985. Contract AC02-76ER04178. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001851.

Research activities have been directed toward four thrust areas: synthesis and characterization of linked redox reagents; study of charge transport in redox polymers derived from monomers consisting of linked viologen and quinone groups; photoelectrochemical oxidation of dithiocarbamates and thiols at CdS and CdSe photoanodes; and characterization of high surface area redox catalysts for CO_2 reduction.

2509 BATTERIES

7324 **Composition gradients in electrolyzed LiCl-KCL eutectic melts.** Vallet, C.E.; Braunstein, J.; Heatherly, D.E. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee). *Journal of the Electrochemical Society;* 130: No. 12, 2366-2369(Dec 1983).

Analysis of transport in a mixed electrolyte has previously predicted significant composition gradients in the LiCl-KCl electrolyte of high temperature Li/S batteries. Composition gradients in quenched electrolyzed LiCl-KCl eutectic contained in yttria felt are measured with high distance resolution by scanning electron microscopy with energy dispersive x-ray spectroscopy. The reported results include composition profiles of LiCl-KCl contained in porous Y_2O_3 and electrolyzed in three cells, two with solid Li-Al electrodes and one with a porous Li-Al anode.

29 ENERGY PLANNING AND POLICY

2901 ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 7354

7325 **(DOE/CE/64780—T4) [Institutional Conservation Program Energy Use Data Base]. Quarterly report, July 1-November 30, 1985.** (Unified Industries, Inc., Springfield, VA (USA)). 1985. Contract FG01-84CE64780. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003869.

Energy accounting software packages in the public domain and in the commercially available fields are discussed. (DLC)

7326 **(EIR—558) Cost-optimized energy supply scenarios for Switzerland.** Kypreos, S.; Kesselring, P. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jul 1985. 39p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE86750722.

EIR reports Nos. 485 and 516 gave prognostications of the possible cast of roles played by the energy carriers concerned in the year 2000. The report on hand provides additional information bearing on the results of report No. 516 by making sensitivity studies on the variability of gas prices in relation to the oil price and on the variability of system efficiency of oil-fuelled and gas-fuelled heating systems. For better understanding of the fundamentals, the report explains the specific properties of linear optimization programmes both in theory and by means of an example (annex).

7327 **(EUR—9177) Some computational problems related to the Efom 12C model.** Smeers, Y. (Commission of the European Communities, Luxembourg). 1984. 28p. Commission of the European Communities, Luxembourg.

We review three questions related to the numerical treatment of the EFOM 12C model. A first problem is the reconstruction of the dual variables of the EFOM 12C after its reduction and optimization. Because of its size, the EFOM 12C model is normally reduced prior to its optimization. The software RECREATOR allows one to reconstruct the optimal primal variables of the original problem but does not consider the question of the dual variables. The report discusses how these can be obtained. The two other parts of the report summarize other works conducted in the context of the same project and reported in separate papers. A numerical study of the efficiency of the codes LIFT and DECOMPSX has been conducted on various multiregional multiperiod energy flow models of the EFOM 12C type, various recommendations are made in this context. Finally a new nested decomposition algorithm that simultaneously exploits the multiregional and multiperiodic structure of the constraint matrix has been developed.

7328 **(EUR—9443) European project for a multinational macrosectoral model.** d'Alcantara, G.; Italianer, A. (Commission of the European Communities, Luxembourg). 1984. 192p. Commission of the European Communities, Luxembourg.

This paper describes the HERMES project, a multinational macrosectoral European econometric modelling effort, sponsored by the Directorates General II (Economic and Financial Affairs), XII (Science, Research and Development), XVII (Energy) and the SOEC. The set-up of the model is sketched against the background of problems of growth, unemployment, inflation, trade balances, government balances and energy policy. Although the definitions of the variables and a complete specification of the model are given in the Appendix, the major features of the model are described extensively in the text. These include private and collective consumption (incl. a consumer demand system), the putty-clay production process, price and wage formation, sectoral bilateral trade flows and integrated energy economy modelling.

2902 ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 6948, 6951, 7213, 7328

2903 ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 7403, 7799, 7830

2904 NATURAL RESOURCES

7329 **(DOE/CP/11936—T1) Program report on Department of Energy Interagency Contract.** (Council of Energy Resource Tribes, Denver, CO (USA)). Nov 1985. Contract AC01-84CP11936. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86003365.

The primary objective of the 1984 Interagency Contract was to encourage the development and effective management of Indian-owned energy. In fulfilling this objective, in 1984-85 CERT (Council of Energy Resource Tribes) continued to respond to specific tribal technical assistance needs by successfully completing 34 energy-related projects that focused on tribal governance, energy development and management of Indian owned energy, consistant with the provisions of the Interagency Contract. Technical assistance was provided to the northern tribes in fourteen projects. The souther tribes, participated in thirteen projects, and seven projects were multi-tribal. CERT staff expertise in areas of financing, economics, contract negotiations, regulatory compliance, project management, environmental protection and management information systems was utilized to complete these projects.

7330 **(LA—10282-MS) Employment generating projects for the energy and mineral sectors of the Dominican Republic.** Loose, V.W. (Los Alamos National Lab., NM (USA)). Oct 1985. Contract W-7405-ENG-36. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86004376.

A mission to the Dominican Republic, sponsored by the Organization of American States, comprised 23 experts in areas of interest to the Country and addressed efforts to generate employment in the Dominican economy. In the energy sector, the mission recommended projects to create energy farms and to encourage industrial energy conservation, as well as a number of smaller projects. Small-scale mining of gold, lignite, and rock salt and the expansion of the semiprecious gem industry were among the recommendations made for the mining sector.

2905 RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 7375, 7799

7331 **(DOE/ER/10008—T1) Institutional support for the Utah Consortium for Energy Research and Education. Final report.** (Utah Univ., Salt Lake City (USA)). Dec 1985. Contract AT03-77ER10008. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003763.

Scope of the Consortium plan was the marshalling of the academic research resources, as well as the appropriate non-academic resources within Utah to pursue energy-related research activities: Solving Social and Economic Problems Related to Energy Development, Institutional Support for Research, Investigation of Labile Compounds from the Pyrolysis of Oil Shale in High Vaccum, Manpower Requirement for Geothermal Energy Development, and Utah/Great Basin Energy Facility Siting Study.

7332 **(DOE/NBM—6004155) North Carolina Energy Institute. Final report.** Bresee, J.C.; Culbreth, C.D. (North Carolina Dept. of Commerce, Raleigh (USA). Energy Div.). 3 Sep 1985. 72p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86004155.

The North Carolina Energy Institute (NCEI) was formed by executive order of Governor James B. Hunt, Jr. on January 3, 1978 to identify and support energy research projects of special value to the State. It ended its official life on June 30, 1982 when its remaining functions were transferred to the North Carolina Energy Division. Some of the projects selected by the Institute for contract support continued in 1984, but essentially all research results were available on December 31, 1983. Probably the most significant legacy of the Institute was its role in the establishment of a long-term alternative energy research program in the State: the North Carolina Alternative Energy Corporation (NCAEC). The NCEI research projects were usually small (average funding - $26,500) and of a preliminary nature. No project was funded for a second time. Of the seventy-four projects sponsored by NCEI, more than twenty on either passive solar projects or wood energy projects were technically and economically successful. Other successful programs include cogeneration, small hydropower, and energy conservation.

2906 NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 6986, 7000, 7255, 7830

7333 **(CRS—IB-75012) Nuclear waste management issue brief number IB75012.** Behrens, C.E. (Library of Congress, Washington, DC (USA). Congressional Research Service). 29 Nov 1982. 14p. Congressional Research Service, The Library of Congress, Washington, DC. File Number TI85902172.

The development of nuclear energy as a source of commercial power in the United States involves several controversial issues. Among the most enduring has been the disposal of intensely radioactive wastes from used nuclear fuels. Disposal of other, less radioactive waste materials also presents problems. Can high-level wastes be disposed of so that surveillance and monitoring while they remain dangerous will not be necessary. If not, what is to be done with the millions of gallons of similar wastes already produce by the military weapons program and currently stored in surface tanks. Assuming safe and reliable technology can be developed, what is the optimum role of the Federal Government, the States, and industry in managing both high-level and low-level wastes.

Will storage capacity for spent nuclear fuel be adequate until a waste management program is adopted and functioning, or will some operating reactors be forced to shut down. Two points are at issue. The first is the adequacy and timing of the Federal Government's nuclear waste management program. The second is the development and expansion of nuclear power; whether it should be delayed of halted until a satisfactory means of solving the waste disposal problem can be demonstrated. The types of waste, the waste management program, legislative issues, and legislation are covered briefly.

7334 **(NRC—5902170) Fuel cycle regulatory perspectives for 1978.** Smith, C.V. Jr. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). 1978. 14p. (NRC—003; CONF-7803135—2). NTIS, PC A02/MF A01 - GPO. File Number TI85902170.

From Fuel cycle conference; New York, NY, USA (5 Mar 1978).

NRC progress during the past year and perspectives for the immediate future are reviewed. Some of the areas are: uranium milling activities; spent fuel storage; decommissioning of fuel cycle facilities; high-level waste management; and low-level waste management.

2907 TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 7316

2908 WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 7214

2910 CONSERVATION

REFER ALSO TO CITATION(S) 7330

7335 **(DOE/CE—0115/3) FEMP Update: Federal Energy Management activities, October 1985.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Federal Energy Management Program Staff). Oct 1985. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002019.

The FEMP Uptake, published quarterly by the Federal Energy Management Program (FEMP), provides information on program developments and successful energy conservation techniques. To encourage energy conservation at all levels of government and to promote the interchange of successful conservation projects, FEMP has expanded the Update to include Technology Transfer and Professional Development.

7336 **(DOE/CS/62029—T2) History of the Nebraska Energy Office, 1985. Creative genius of energy: a decade of celebration.** Meiere, H. (Nebraska Energy Office, Lincoln (USA)). 1985. Contract FG47-77CS62029. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003940.

The energy crunch of the early 1970's forced Nebraskans to acknowledge the prominent role energy plays in the economic health of Nebraska. Since that time, the State of Nebraska, through an effective response to the existing crisis and forward-looking planning for the future, has turned a short-term economic disaster into potential for security and economic growth in the long term. Spearheading those efforts have been the Nebraska Energy Office and its legislative and administrative supporters. Through innovative approaches to meeting the energy demands of all Nebraskans, the Nebraska Energy Office continues to give individuals, agencies, businesses, and communities needed solutions to their energy problems and to expand their awareness of Nebraska's energy potential.

7337 **(PUR—17) Resource allocation, two-dimensional constraints and discrete dynamic programming.** Baker, N.R.; Yormark, J.S. (Purdue Univ., Lafayette, IN (USA). Purdue Lab. for Applied Industrial Control). 1968. 37p. (CONF-681153—1). NTIS, PC A03/MF A01. File Number DE85901837.

From National meeting of the Operations Research Society of America; Philadelphia, PA, USA (6 Nov 1968).

This paper considers the allocation of a scarce resource when the allocation is simultaneously restricted by constraints on two entities, e.g., when both time period and activity constraints are imposed. The major assumption is that return from an allocation to an activity during a single time period is independent of allocations made to the same activity during other time periods or to other activities during the same or other time periods. This two-dimensional resource allocation problem is formulated as a discrete dynamic programming problem, a (0,1) programming problem, and a capacitated transportation problem. The assumptions underlying each formulation are made explicit. Optimal dynamic programming procedures are developed for certain partially constrained forms of the problem and are shown to solve analogous classes of (0,1) programming problems. The general two-dimensional problem remains unsolved; however, an upper bound on the value of the objective function has been found, an iterative search solution procedure has been suggested, and two promising search algorithms are being evaluated.

2920 SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 6949, 6960, 7214, 7376

7338 **(K/OP—276) Analysis of changes in national energy forecasts during the 1970s.** Prince, B.E. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 18 Jul 1980. Contract AC05-84OT21400. 61p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86003589.

An analytical survey was made of the major issues which have led to modifications in national energy forecasts during the past decade. Historical developments and growth trends in energy use prior to the 1970s are reviewed briefly in this report, as are the particular events of the 1970s which have begun to reshape these trends for the future. Several energy policy studies made during the past decade were also examined, and some of the major issues in controversy affecting prospects for future growth of energy supply and demand are identified. Some typical energy forecast-scenarios for the year 2000 are then discussed in relation to these issues. It is shown that a wide span of possible supply and demand growth scenarios can result, depending on assumptions concerning these issues. Finally, prospective trade-offs between expanding fuels supply and moderating total energy consumption for the year 2000 were examined quantitatively. Providing no additional major restrictions or disruptions occur in supplies of petroleum and natural gas, the analysis indicates that coal and nuclear power can compensate for scarcities in these fuels and meet total energy requirements, after accounting for probable impacts of energy conservation and slower growth of the economy. 40 refs., 10 figs., 10 tabs.

7339 **(NP—6770052) Structural change in the energy supply of the Federal Republic of Germany.** (Bundesverband der Deutschen Industrie e.V., Koeln (Germany, F.R.)). Feb 1984. 36p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE86770052.

The following discussion describes the considerable structural shifts which have taken place in the F.R.G.'s energy supply over the past 20-30 years, as a result of persistent changes on world energy markets and which are expected in the next few years. This structural change has, in the F.R.G., been supported by energy policy which compared to other important countries, grants clear priority to the control of market forces and employs only continously state intervention. The efficiency of this policy can be seen by the extent of energy saving and by the considerable extension of the basis of supply and the accompanying decrease in supply risks. It may, therefore, be taken as an example of overcoming structural problems using primarily market forces.

2930 POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 7360, 7396, 7403

7340 (SLAC-PUB—3791) Alternate policies for alternate energy sources. Hall, F.F. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1985. Contract AC03-76SF00515. 13p. (CONF-851201—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003863.

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

Some "alternates within alternates" are studied and possible improvement of our energy policies are explored. The viability of a hydrogen fuel economy is reviewed. Methanol, ethanol or ammonia versus hydrogen is one area of interest. Others include liquid hydrogen versus jet fuels, the use of geothermal, solar, wind or water energy for production of hydrogen gas versus development of deep earth supplies of natural gas is another. Energy enhancement as opposed to energy conservation is investigated with regard to polar climate and what might be done to improve natural energy balances, particularly in the northern hemisphere. Pumping Arctic Ocean water out into the Pacific Ocean via the Bering Strait would be an energy debit as opposed to energy gains such as biomass conversion of future plant growth throughout the Siberian and Canadian tundra regions and presently very arid desert regions, improved access to northern region fuel, metal ore and mineral resources, year-round shipping and fishing fleet operations in the Arctic Ocean and development of the tremendous Greenland hydro-electric power potential.

2940 FOSSIL FUELS

REFER ALSO TO CITATION(S) 6948, 6949, 6950, 6951, 6960

2950 HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 7340

2960 ELECTRIC POWER

7341 (DOE/EIA—0226(80/06)) Electric Power Monthly, June 1980. (USDOE Energy Information Administration, Washington, DC. Office of Coal and Electric Power Statistics). 24 Sep 1980. 130p. NTIS, PC A07/MF A01 - GPO; GPO Dep. File Number DE86002475.

June 1980 coal consumption increased 4.1% from the June 1979 figures. Coal stocks as of July 1, 1980 were 179.0 million short tons. Stocks increased 30.9% above the July 1, 1979 stocks of 136.8 million short tons. Steam, gas turbine, and internal combustion plants consumed 30.8 million barrels of oil in June 1980. June 1980 oil consumption was 26.0% below the June 1979 figures. The sum of the noncoincident peak electrical loads in May 1980 was 334,384 megawatts, a 0.6% decrease from May 1979.

7342 (DOE/EIA—0226(80/11)) Electric Power Monthly. (USDOE Energy Information Administration, Washington, DC. Office of Coal and Electric Power Statistics). Nov 1980. 129p. NTIS, PC A07/MF A01; 1 - GPO; GPO Dep. File Number DE86002470.

This report presents monthly summaries of electric utility statistics at the national, regional, state, or local levels on the following subjects: net generation, net energy for load, peak load and net capability, consumption (fuel), stocks (fuel), deliveries (fuel), and price (fuel deliveries and retail electricity).

7343 (DOE/EIA—0226(80/12)) Electric Power Monthly, December 1980. (USDOE Energy Information Administration, Washington, DC. Office of Coal and Electric Power Statistics). 2 Mar 1981. 131p. NTIS, PC A07/MF A01; 1 - GPO; GPO Dep. File Number DE86002469.

This report presents monthly summaries of electric utility statistics at the national, regional, state, or local levels on the following subjects; net generation; net energy for load; peak load and net capability; consumption (fuel); stocks (fuel); deliveries (fuel); and price (fuel deliveries and retail electricity.

7344 (DOE/EIA—0226(81/01)) Electric Power Monthly, January 1981. (USDOE Energy Information Administration, Washington, DC. Office of Coal and Electric Power Statistics). 7 Apr 1981. 134p. NTIS, PC A07/MF A01; 1 - GPO; GPO Dep. File Number DE86002477.

The Electric Power Monthly is designed to provide information about electric power production and consumption in a concise format. It presents monthly summaries of electric utility statistics at the national, regional, state, or local levels on the following subjects; stocks (fuel); receipts (fuel); consumption (fuel); net generation; net energy for load; peak load and net capability; cost (fuel receipts); and retail prices. Chapters on Stocks, Receipts, Consumption and Net Generation present data first for the total United States, followed by data summaries at the regional level and the state level. Chapters on New Energy for Load, and Peak Load and Net Capability present United States' totals first, followed by regional data. The chapter on cost provides national averages followed by state averages, while the Retail Prices chapter presents United States averages followed by local averages.

7345 (DOE/EIA—0226(81/03)) Electric Power Monthly, March 1981. (USDOE Energy Information Administration, Washington, DC. Office of Coal and Electric Power Statistics). 4 Jun 1981. 136p. NTIS, PC A07/MF A01 - GPO; GPO Dep. File Number DE86002478.

This report presents monthly summaries of electric utility statistics at the national, regional, state, or local levels on stocks (fuel), receipts (fuel), consumption (fuel), net generation, net energy for load, peak load and net capability, cost (fuel receipts), and retail prices. Chapters on Stocks, Receipts, Consumption and Net Generation present data first for the total United States, followed by data summaries at the regional level and the state level. Chapters on Net Energy for Load, and Peak Load and Net Capability present United States' totals first, followed by regional data. The chapter on cost provides national averages followed by state averages, while the Retail Prices chapter presents United States averages followed by local averages.

7346 (DOE/EIA—0226(81/04)) Electric Power Monthly, April 1981. (USDOE Energy Information Administration, Washington, DC. Office of Coal and Electric Power Statistics). 6 Jul 1981. 136p. NTIS, PC A07/MF A01 - GPO; GPO Dep. File Number DE86002479.

The Electric Power Monthly presents monthly summaries of electric utility statistics at the national, regional, State, or local levels on the following subjects: stocks (fuel); receipts (fuel); consumption (fuel); net generation; net energy for load; peak load and net capability; cost (fuel receipts); and retail prices. The publication covers each of these subjects in a separate chapter. Chapters on Stocks, Receipts, Consumption and Net Generation present data first for the total United States, followed by data summaries at the regional level and the State level. Chapters on Net Energy for Load, and Peak Load and Net Capability present United States' totals first, followed by regional data. The chapter on cost provides national averages followed by State averages, while the Retail Prices chapter presents United States averages followed by local averages. Each chapter contains related text, tables, or graphs.

7347 (DOE/EIA—0226(81/07)) Electric Power Monthly, July 1981. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 6 Oct 1981. 135p. NTIS, PC A07/MF A01; 1 - GPO; GPO Dep. File Number DE86002481.

The installed generating capacity of US electric utility plants was 627,475 megawatts (MW), of which 436,892 were in fossil steam, 76,913 in hydroelectric, 57,205 in nuclear, 50,932 in gas-turbine, and 5534 in internal-combustion plants. During July 1981, electric power generation in the United States set a new record of 220,164 gigawatthours (GWh). Coal accounted for 51.3% of all electricity produced, hydropower for 11.4%, oil for 9.1%, natural gas for 17.5%, nuclear power for 10.5%, with the remaining 0.2%

from geothermal, wood and waste, and petroleum coke. Average retail prices of electricity rose in July 1981 to $35.39 for 500 kilowatthours (kWh) from $31.64 in July 1980, an increase of 11.9%. New York City's rates for residential consumption of 500 kWh were the highest in July of the 40 cities at $78.76, while Seattle's rates were the lowest at $5.84. Average prices for industrial use of electricity in July 1981 compiled from statistics from 25 US cities, rose 14.6% from a year earlier, while commercial rates rose 12.5%. The Bureau of Labor Statistics' all-items Consumer Price Index showed an increase of 10.7% for the same period.

7348 **(DOE/EIA—0226(83/01)) Electric Power Monthly, January 1983.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 19 Apr 1983. 38p. NTIS, PC A03/MF A01; 1 - GPO; GPO Dep. File Number DE83011098.

During January 1983, net generation by electric utilities in the United States was 195,680 gigawatthours (GWh), an increase of 5.9% from December. In January, coal accounted for 55.3% of all electricity produced, petroleum for 6.6%, natural gas for 10.1%, nuclear power for 12.8%, hydroelectric power for 15.0%, with remaining 0.3% from geothermal, wood, and waste at central stations only. In January 1983, electric utilities consumed 53,351 thousand short tons of coal, an increase of 4.8% from the previous month. Petroleum consumption increased 14.8% from December to 21,850 thousand barrels in January. Utilities also consumed 208,337 million cubic feet of natural gas in January, down 2.9% from December. In January, 16.6 thousand short tons of petroleum coke were consumed by utilities. Electric utilities' end-of-month coal stocks for January 1983 were 177,832 thousand short tons, 1.8% lower than in December 1982. Coal stocks at the end of January 1983 were also 12.2% larger than stocks at the end of January 1982. End-of-month petroleum stocks at the end of January 1983 were 119,196 thousand barrels, 0.3% larger than stocks in December but 1.3% less than stocks a year ago.

7349 **(DOE/EIA—0226(85/08)) Electric Power Monthly, August 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 15 Nov 1985. 44p. NTIS, PC A03/MF A01 - GPO; GPO Dep. File Number DE86003383.

During August 1985, net generation by electric utilities in the United States was 226,050 gigawatthours. Net generation by electric utilities in the three northeastern power pools consisting of New York and New England power pools and the Pennsylvania-New Jersey-Maryland (PJM) Interconnection for August 1985 was 31,476 gigawatthours, nearly 14% of total US net generation. On a year-to-date basis, net generation at the end of August 1985 was 1.2% higher than for the same period in 1984. In August 1985, coal accounted for 56.0% of all electricity produced, petroleum for 4.4% gas for 15.0%, hydroelectric power for 8.8%, nuclear power for 15.4%, with the remaining 0.4% from geothermal, wood, wind, waste, and solar.

7350 **(DOE/RG—0066) Electricity transactions across international borders, 1984.** (USDOE Economic Regulatory Administration, Washington, DC. Coal and Electricity Div.). Oct 1985. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001000.

This report summarizes the electricity exchanges between the United States and Mexico and Canada during calendar year 1984. The construction, operation and maintenance of any electric transmission facility which crosses an international border of the United States requires a Presidential permit. These permits have been granted by DOE since its formation in 1977. During 1984, the US imported 42,219,259 MWh of electric energy at a cost of $1,070,046,345. Of this total, 42,034,392 MWh were imported from Canada and the remainder (184,867 MWh) were received from Mexico. During this same period, US exports of electric energy totaled 2,558,293 MWh with gross revenues of $21,795,733. Of this, 2,479,487 MWh representing $21,115,413 in revenues were delivered to Canada, and 78,806 MWh representing $680,320 in revenues were delivered to Mexico. On a net basis, the US was an importer of 39,660,966 MWh of electric energy. These 1984 values constitute an increase of 9.2% in gross imports and a decrease of 23.3% in gross exports compared to 1983 levels.

7351 **(EPRI-EA—4314) Demand-side planning: Sierra Pacific Power Company case study. Final report.** McDonald, C. (Synergic Resources Corp., Seattle, WA (USA)). Nov 1985. 92p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920068.

Sierra Pacific Power Company used four EPRI-developed software packages to help create a balance between demand- and supply-side planning options. Analyses of the methodologies used to develop Sierra Pacific Power's integrated resource plan - a milestone in the evolution of demand-side management - can be helpful to utilities considering similar programs.

7352 **(EPRI-EA—4347) Value of a power plant's remaining life: a case study with Baltimore Gas and Electric Company. Final report.** Farber, M. (Temple, Barker and Sloane, Inc., Lexington, MA (USA)). Nov 1985. 65p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920073.

An approach to production cost analysis supporting economic evaluations of the remaining life of powerplants was developed. The approach has been implemented on a microcomputer in a spreadsheet model, which requires significantly less computer and staff resources than traditional production cost models, yet retains virtually all the accuracy of these full-scale models for the analysis of a broad set of plant remaining life issues. The model has been validated and illustrated with a case study of Baltimore Gas and Electric Company.

7353 **(LA—10515-MS) Economics of electric utility rate phase-in.** Goodman, D.E.; Smith, D.M. (Los Alamos National Lab., NM (USA)). Aug 1985. Contract W-7405-ENG-36. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001231.

Since 1980, a number of large, expensive generating units have been built by electric utilities. These plants represent a large portion of the utility's rate base when they enter service. As a consequence, rates paid by consumers can increase dramatically when the plant enters the rate base. A number of systems have been proposed to phase in the rate increases in order to mitigate the impacts of entering a new plant in the rate base. All phase-in schemes must address the interests of three parties: (1) utility companies, (2) electricity consumers, and (3) utility company regulators. The most commonly discussed phase-in methods are (1) Negative CWIP, (2) Altered Depreciation, (3) Post-operational Phase-In, (4) Economic Depreciation, and (5) Levelized Payments. Utilities in theory, are indifferent as to which method to use as long as there is assurance that they will be adequately paid. Consumers prefer methods that postpone rate increases as long as possible. Regulators are indifferent as to which method is used as long as both utility companies and consumers are satisfied. No single phase-in system is clearly preferable under all circumstances. The best phase-in method must be determined on a case-by-case basis.

7354 **(NP—6770053) Long-term planning of the energy utilization of power plant systems considering stochastic influences.** Schroeder, T.J. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Elektrotechnik). 3 Jul 1984. 116p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE86770053.

First of all this paper analyses the task of long-term planning of energy utilization and related problems, the structure of power plant systems in the Federal Republic of Germany and data base available in this connection, and already existing methods of long-term energy utilization planning. In the next step a mathematical system model is developed which describes long-term energy utilization planning as a stochastic, nonlinear optimization task. Subsequently a procedure on the basis of successive linear programming is developed which permits iterative solution of an approximated linearized computation model derived from the system model. In the following chapter the impact of necessarily stochastic data such as load projection errors and unit outage behaviour on the calculation of the cost of operation and on the quality of the long-term planning of energy utilization is quantitatively determined by taking as examples three power plant systems simulated from real power plant systems in the Federal Republic of Germany. The method

here described is thus first to permit long-term planning of energy utilization on a combined deterministic-and-stochastic basis with the aid of a mathematical optimization method also for power plant systems including thermal power plants whose energy conditions are not constant over the year.

7355 **(TVA/PE/OPS—84/6) Which is cheaper? A small or a large unit.** Bashambu, R.L.; Yates, R.L. (Tennessee Valley Authority, Chattanooga (USA). Div. of Operations Support). 1985. 9p. (CONF-8506166—1). NTIS, PC A02/MF A01. File Number DE85901742.

From 29. annual meeting American Association of Cost Engineers; Denver, CO, USA (30 Jun 1985).

Larger units generally offer the potential for economies-of-scale in both price and manpower requirements and a better heat rate that can greatly reduce the real cost of power generation. On the other hand, smaller units generally offer higher availability, thus resulting in a higher system reliability for a given capacity addition and a proportionately higher load carrying ability. This paper takes a fresh look at the optimum unit size of additional generating capacity under current economic parameters, uncertain load demand, and long leadtimes for building larger units.

2980 CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 7374, 7399, 7402

7356 **(DOE/EIA—0035(85/08)) Monthly Energy Review, August 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 25 Nov 1985. 133p. NTIS, PC A07/MF A01; 1 - GPO; GPO Dep. File Number DE86003760.

Current data on US production, consumption, stocks, imports, exports, and prices of principal energy commodities are reported for each month of 1983 through the most recent month of 1985, and for each year from 1973 through 1985. Quarterly summaries for the current year are also provided. Energy sources covered are crude oil, petroleum products, natural gas, coal, nuclear power, and electric utilities. Also reported are energy consumption by sector, selected energy indicators, and oil and gas resource development. For selected other countries in the world, production, consumption, and stocks of petroleum and electricity generation by nuclear power plants are presented. Conversion factors and a glossary are provided, along with feature articles on current energy topics.

2990 UNCONVENTIONAL SOURCES AND POWER GENERATION

7357 (CONF-850297—, pp 374-396) **Impact of biomass availability on selection of energy systems.** Shukla, P.R.; Moulik, T.K. (Indian Institute of Management, Ahmedabad). 1985. NTIS, PC A19. File Number DE85017291.

From 2. USAID/GOI workshop on alternative energy resources and development; New Delhi, India (4 Feb 1985).

This paper assesses the impact of biomass availability on the selection of energy systems, allocation of energy to various energy needs and energy costs for a village. Proposals regarding development of biomass resources and subsidizing biomass based energy systems are considered. The analysis is based on optimal energy systems selection, energy allocations and costs for four villages under existing conditions and under various proposals using an optimization model. 2 refs., 8 tabs.

7358 (CONF-8202111—, pp 1-32) **Present level of technology and development problems of small-scale wind power plants.** Fritzsche, A. 1982. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770042.

From Seminar on questions on application and strategies for the use of small wind power plants; Juelich, F.R. Germany (11 Feb 1982).

In order to discuss possible uses for small wind power plants and the export opportunities, a general view of the present level of technology, market potential and the cost situation and economic viability of these plants is given. At the same time, the present general facts regarding the energy industry and energy policies are subjected to an assessment with respect to their influence on small wind power plants.

7359 **Integrated palm oil processing.** Compere, A.L.; Googin, J.M.; Griffith, W.L. (Oak Ridge National Lab., Oak Ridge, TN). pp 515-322 of Alternative energy sources VI: Vol. 2: solar applications/waste energy. Veziroglu, T.N. Washington, DC; Hemisphere Publishing Co. (1985). (CONF-831205—).

From 6. Miami international conference on alternative energy sources; Miami Beach, FL, USA (12 Dec 1983).

Tree palms are a promising source of fuel extenders and substitutes. They are perennials which bea oil for a period of two to three decades after a roughly four year preliminary growth period. Because palms are an important crop in many areas of Asia, Africa, and South America, considerable attention has been given to palm genetic improvement, with the result that tree palms are one of the most efficient energy crops: the best modern varieties can provide up to 6 tonnes per hectare per year of mesocarp and kernal oils. Palms are particularly attractive in areas where more conventional farming would pose a significant threat of laterization or cause major ecological problems. Technology for palm oil production can range between village level manual operations and highly industrialized mills. Process energy is often supplied by combustion of by-products. Although palm oil is a good energy crop, its physical and combustion properties preclude most use in conventional diesel engines, although palm oil could be directly blended with residual fuel oils for use in some large engines. At present, two uses for palm oil as a diesel fuel extender or substitute appear attractive: microemulsion blends using palm soapstock and monoesters produced by exchanging small alcohols for the glycerol in triglycerides.

7360 **Energy, innovation, and the business cycle: proof and policy.** Santini, D.J. (Argonne National Lab., Argonne, IL). pp 299-312 of Alternative energy sources 6: Vol. 4: conservation/management/policy. Veziroglu, T.N. Washington, DC; Hemisphere Publishing Co. (1985). (CONF-831205—).

From 6. Miami international conference on alternative energy sources; Miami Beach, FL, USA (12 Dec 1983).

As a result of the world recession, interest in long wave economic theories of Kondratiev (1925) and Schumpeter (1939) has revived. Recently, Mensch (1975), Freeman et al. (1982), Marchetti (1980), and the author (1983), have developed different theories which each link innovation to economic cycles. Rosenburg and Frischtak (R & F) (1982) have specified conditions which must be met if innovation-induced long wave theories are to be proven. The conditions are generally valid but are improperly specified in some respects. This paper evaluates and contrasts the theories in light of original and respecified R&F conditions. U.S. evidence previously presented by the author implies innovation-induced wavelike macroeconomic behavior but not long wave behavior. In the long run, each theory implies that actions by government to encourage invention and innovation will expand economic growth. The theories differ in their short run policy implications. The author's theory emphasizes the key role of energy intensive sectors of the economy and predicts negative short run macroeconomic effects of energy related innovation. Other theories emphasize the benefits of all types of innovation. Policy based on the author's theory would support steady R & D to develop successful, dependable, rapidly implementable new energy related technologies to be heavily promoted after an energy price shock.

30 DIRECT ENERGY CONVERSION

3001 MHD GENERATORS

REFER ALSO TO CITATION(S) 7180, 7181, 7182

7361 **(DOE/ET/10815—111) [University of Tennessee Space Institute energy conversion programs]. Quarterly technical progress report, January-March 1985.** (Tennessee Univ., Tullahoma (USA). Space Inst.). Nov 1985. Contract AC02-79ET10815. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86003456.

In this Quarterly Technical Progress Report, UTSI reports on progress in research, development, and testing for MHD steam power plant bottoming cycle components. Installation of the baghouse and procurement of the electrostatic precipitator (ESP) for comparative side-by-side evaluation in cleaning up MHD exhaust particulate are reported. The status of the DOE Coal Fired Flow Facility and preparations of the facility and flow train for resumption of testing, including the environmental baseline program, are reported. Specific actions pertaining to the flow train that are covered include the fabrication of two new combustor modules with designs intended to improve reliability, the assembly of the MHD generator for use in integrated system testing, and modifications to the radiant furnace slag tap and heat transfer surface. Data analysis of data taken during CY1984 testing is presented in the areas of NO/sub x/ control, heat transfer, and diagnostic. A preliminary report is included of a system study to determine the optimum stoichiometry for an MHD power plant in a economic sense. Research efforts directed toward recovery of seed and processing for re-use in the MHD system are reported. 9 refs., 60 figs., 12 tabs.

7362 **(DOE/ET/10815—112) [University of Tennessee Space Institute energy conversion programs]. Quarterly technical progress report, April-June 1985.** (Tennessee Univ., Tullahoma (USA). Space Inst.). Nov 1985. Contract AC02-79ET10815. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003457.

The installation and initial shakedown test results of the baghouse are reported. Status of the design and fabrication of the ESP and installation engineering is presented. Facility preparations for conduct of the first test in the LMF4 series are detailed. The status of environmental monitoring of air, water and terrestrial ecology is discussed. The flow train component performance is reported with primary emphasis on process gas analysis, heat transfer in the downstream components, fouling and corrosion of metallic surfaces. The advanced diagnostics utilized in the test conducted this quarter are discussed as are the plans for the diagnostics to be included in the balance of the tests during calendar year 1985, including those provided by Mississippi State University. Finally, a status report is given on the results of efforts in the seed recovery/reprocessing area. 8 refs., 5 figs., 5 tabs.

7363 **(NLR-MP—84053-U) Channel design for closed cycle MHD.** Troost, G.K.; Kemper, C.A.L.; Verbruggen, T.W.; Van der Wijngaart, R.F.; Lindhout, J.P.F.; Van der Draai, R.K. (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam (Netherlands)). May 1984. 19p. Nationaal Lucht- en Ruimtevaartlaboratorium, P.O. Box 90502, 1006 BM Amsterdam, Netherlands.

System design studies for medium scale power plants with a closed cycle MHD topping have been performed. These studies show a potential for early commercialization of the direct energy conversion technology for both coal and natural gas fired utility installations. As a first step towards the large scale application of MHD, this technology can demonstrate an economically high enthalpy extraction on an intermediate scale. The closed cycle MHD power train, and in particular the generator, has been studied in detail and a basic design configuration has been defined. (A.V.)

7364 **(DOE-tr—273-Vol.6, pp 6E15.1-6E15.8) Status of magnetohydrodynamic testing at the US Department of Energy's Component Development and Integration Facility.** Sherick, J.M.; Staats, G.E. (Mountain States Energy, Inc., Butte, Montana). 1983. Translation source information not available . NTIS, PC A16. File Number DE85018282.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth International Conference on MHD Electrical Power Generation. Vol. 6.

This paper summarizes the status of magnetohydrodynamic (MHD) testing at the Component Development and Integration Facility for the past ten months. This facility has been commissioned by the United States Department of Energy to test magnetohydrodynamic components and to provide development data at the nominal 50 megawatts thermal input level. Included is the Component Development and Integration Facility (CDIF) testing projection for the future as presently defined. 1 ref., 5 figs.

7365 **(DOE-tr—273-Vol.6, pp 6H15.1-6H15.8) Development status of the TRW 20 megawatt thermal magnetohydrodynamic coal combustor.** Bauer, M.; Braswell, R.; Iwata, H.; Stewart, J. (TRW Energy Development Group, Redondo Beach, California). 1983. Translation source information not available . NTIS, PC A16. File Number DE85018282.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth International Conference on MHD Electrical Power Generation. Vol. 6.

This paper presents the results of recently completed, Department of Energy (DOE) sponsored, 20 megawatt thermal magnetohydrodynamic (MGD) coal combustor development work at TRW. The results of TRW's 20 megawatt thermal coal combustor development work through 1981 have been reported in previous magnetohydrodynamic conferences. Here we present the 1982 accomplishments. Specifically, the combustor related results of the recently completed 20 megawatt thermal coal fired power generation tests performed jointly by TRW and AVCO are discussed. For this test series, an existing TRW 20 megawatt thermal slagging coal combustor and a supersonic AVCO channel were integrated and installed in the AVCO Mark Six generator facility with a 4 Tesla iron core magnet and tested for 24 thermal hours and 4.5 power hours. The present paper focuses on the combustor operating characteristics resulting from these tests and we summarize the mechanical interface issues that were addressed. We also present current test results from the 20 megawatt thermal magnetohydrodynamic coal combustor oxygen enriched, low preheat development work recently completed at TRW. This new development activity was designed to define the operational and hardware changes necessary to operate the combustor at a 900 to 1,200F preheated oxidant temperature rather than the baseline 2,900F preheat temperature used in all previous tests. 12 figs., 5 tabs.

7366 **(DOE-tr—273-Vol.6, pp 6M20.1-6M20.8) Radial electric field limitations in open cycle disk generators.** Lear, W.E.; Nakamura, T. (High Temperature Gasdynamics Laboratory, Stanford University, Stanford, California). 1983. Translation source information not available . NTIS, PC A16. File Number DE85018282.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth International Conference on MHD Electrical Power Generation. Vol. 6.

Experiments have been performed in the Stanford Inflow Disk Generator Facility with clean fuel and with coal slurry to investigate the radial electric field breakdown phenomena. The results indicate that the presence of the magnetic field has a stabilizing effect on the incipient breakdown, so that higher electric fields may be sustained than in the zero B field case. The breakdown voltage threshold and insulator gap resistance both increased with time as the applied field was maintained, possibly indicating the evaporation of condensed seed material in the clean fuel case, and the polarization and thinning of the slag layer in the coal slurry case. Insulator initiated breakdown was the dominant breakdown mode in all cases. The plasma initiated breakdown threshold was examined via the application of short duration (100 millisecond)

ramp shaped voltage pulses and was found to be consistently higher than the insulator initiated breakdown threshold for insulator gaps studied (3.2 millimeters and 6.4 millimeters). 15 refs., 20 figs., 1 tab.

7367 **(DOE-tr—273-Vol.6) Eighth International Conference on MHD Electrical Power Generation. Volume 6.** (AN SSSR, Moscow. Inst. Vysokikh Temperatur). 1983. Translation source information not available . (OLS—85-15-Vol.6; CONF-830906—Vol.6). 352p. NTIS, PC A16. File Number DE85018128.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

The VIIIth International Conference on MHD Electrical Power Generation was convened at the initiative of the International Liaison Group on MHD Electrical Power Generation by the USSR Academy of Sciences and under the sponsorship of: UNESCO, Council for Mutual Economic Assistance (COMECON), Energoinvest (Yugoslavia), Control Data Corporation (USA), and Bhabha Atomic Research Centre (India). The proceedings of the VIIIth International Conference on MHD Electrical Power Generation contain the results of most recent R and D work aimed at practical realization of this advanced method of electrical power generation. The papers presented to the Conference deal with heat-generating schemes and cycles, conceptual and detail designs of MHD power plants. Considerable emphasis is placed in the Conference proceedings on the problems of testing, designing and mathematical modeling of MHD channels, as well as on the studies into MHD flows, heat transfer, properties and physical processes in plasma, electrode phenomena and diagnostics. Papers have been entered individually into EDB. DOE-tr--273 contains the complete translation of all the papers into English.

3005 FUEL CELLS

7368 **(DOE/ER/30060—T1) Assessment of research needs for advanced fuel cells.** Penner, S.S. (California Univ., San Diego, La Jolla (USA)). Jul 1985. Contract AC01-84ER30060. 237p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86002003.

The DOE Advanced Fuel Cell Working Group (AFCWG) was formed and asked to perform a scientific evaluation of the current status of fuel cells, with emphasis on identification of long-range research that may have a significant impact on the practical utilization of fuel cells in a variety of applications. The AFCWG held six meetings at locations throughout the country where fuel cell research and development are in progress, for presentations by experts on the status of fuel cell research and development efforts, as well as for inputs on research needs. Subsequent discussions by the AFCWG have resulted in the identification of priority research areas that should be explored over the long term in order to advance the design and performance of fuel cells of all types. Surveys describing the salient features of individual fuel cell types are presented in Chapters 2 to 6 and include elaborations of long-term research needs relating to the expeditious introduction of improved fuel cells. The Introduction and the Summary (Chapter 1) were prepared by AFCWG. They were repeatedly revised in response to comments and criticism. The present version represents the closest approach to a concensus that we were able to reach, which should not be interpreted to mean that each member of AFCWG endorses every statement and every unexpressed deletion. The Introduction and Summary always represent a majority view and, occasionally, a unanimous judgment. Chapters 2 to 6 provide background information and carry the names of identified authors. The identified authors of Chapters 2 to 6, rather than AFCWG as a whole, bear full responsibility for the scientific and technical contents of these chapters.

7369 **(DOE/ET/11304—30) Development of molten carbonate fuel cell technology. Technical progress report, October-December 1983.** (Energy Research Corp., Danbury, CT (USA)). 1983. Contract AC02-76ET11304. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003198.

Component development during this quarter concentrated on two objectives: development of a creep resistant ribbed anode and development of an internal reforming catalyst for methane reforming in the MCFC anode environment. Single cell testing is being performed in support of anode and catalyst development, NiO cathode endurance and thin matrix development. Endurance testing of NiO cathodes is being performed to define the economic life of NiO and to identify practical means of extending life. Electrolyte matrix fabrication and testing activity is concentrating on tape cast matrix development.

7370 **(DOE/ET/11304—31) Development of molten carbonate fuel cell technology. Technical progress report, January-March 1984.** (Energy Research Corp., Danbury, CT (USA)). 1984. Contract AC02-76ET11304. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003199.

Component development is concentrating on two primary objectives: development of a creep resistant ribbed anode and development of an internal reforming catalyst for methane reforming in the MCFC anode environment. Single cell testing is being performed in support of anode and catalyst development, NiO cathode endurance and thin matrix development.

7371 **(DOE/ET/11304—33) Development of molten carbonate fuel cell technology. Technical progress report, July-September 1984.** (Energy Research Corp., Danbury, CT (USA)). 1984. Contract AC02-76ET11304. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003200.

Significant progress has been made during this quarter in the areas of internal reforming cell testing, creep resistance anode testing and tape matrix endurance testing. Component development is concentrated on two primary activities: development of a creep resistant ribbed anode and development of a methane reforming catalyst for use within the MCFC anode environment. Single cell testing is being performed in support of anode and catalyst development, nickel oxide cathode endurance and thin matrix development. Endurance testing of NiO cathodes is being conducted to define the economic life of NiO and to identify practical means of extending cathode life. Electrolyte matrix fabrication and testing activity is concentrating on tape cast matrix development.

7372 **(DOE/ET/11304—34) Development of molten carbonate fuel cell technology. Technical progress report, October-December 1984.** (Energy Research Corp., Danbury, CT (USA)). 1984. Contract AC02-76ET11304. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003201.

Significant progress has been made during this quarter in the areas of creep resistant anode development, NiO cathode endurance and tape matrix cell testing.

7373 **(EPRI-EM—4332) Assessment of centralized medium-sized fuel cell power plants. Final report.** Brown, J.P.; Pietrogrande, P.; Tio, T.; Wagner, E.S. (Kinetics Technology International Corp., Monrovia, CA (USA). Research and Development Div.). Nov 1985. 171p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920062.

Cost and performance estimates for 50 to 200 MW fossil-fueled phosphoric acid fuel cells using commercially proven fuel-processing and energy recovery sections are presented. These estimates indicate that this concept offers attractive capital costs, low heat rates, short construction times, and minimal land use for natural-gas-fueled plants.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

7374 **(DOE/CE—0043/3) Annual report on Federal Government Energy Management, fiscal year 1984.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of the Deputy Assistant Secretary for Conservation). Nov 1985. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003964.

During FY 1984, the Government of the United States used 1.9 Quadrillion British Thermal Units (Quads) of energy for buildings, facilities and operations to provide essential services to its citizens, including the defense of the nation. This 1.9 Quads consumed is approximately 2.4% of all energy used in the United States. In

aggregate total the Federal Government is the single largest energy consumer in the nation, although its pattern of consumption is widely disbursed at more than 8000 locations worldwide. The total Federal energy consumption was 1.6% less than FY 1975 - the base year against which energy usage is measured. Total Federal energy consumption in FY 1984 was 3.7% greater than FY 1983, however. The cost of this energy for FY 1984 was $11.7 billion or approximately 1.4% of the toal Federal expenditures of $851.8 billion for all purposes in the last fiscal year. The total amount spent for energy in FY 1984 represented a decrease of approximately $.9 billion from the $12.6 billion reported for FY 1983, although the cost of buildings and facilities energy increased for the year. The continued decline in the cost of jet fuel used in general operations accounted in large measure for the decrease.

7375 **(PNL—5676) Systems analysis research for energy conversion and utilization technologies (ECUT). FY 1985 annual report.** Eberhardt, J.J.; Gunn, M.E.; Levinson, T.M. (Pacific Northwest Labs., Richland, WA (USA)). Nov 1985. Contract AC06-76RL01830. 68p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86003958.

This Annual Report highlights ECUT accomplishments in the Systems Analysis Project for FY 1985. The Systems Analysis Project was established in 1980 along with the ECUT Division. The Systems Analysis mission is to identify, analyze, and assess R and D needs and research program strategies for advanced conservation technologies. The PNL Systems Analysis staff conducts topical research, provides technical studies, and plans program activities in three areas related to energy conversion and utilization technologies: (1) technology assessment, (2) engineering analysis, and (3) project evaluation and review. This report summarizes the technical results and accomplishments of the FY 1985 projects. They relate mostly to tribology, improved ctalysts, regenerative heat exchangers, robotics and electronics industries, and bioprocessing.

3201 BUILDINGS

REFER ALSO TO CITATION(S) 7117, 7118, 7128, 7134, 7781

7376 **(BMFT-FB-T—85-078) Efficient use of energy in connection with city renovation - survey of the model area Berlin old city of Spandau. Summary.** Illing, H.; Kolb, D.; Kranz, K.; Seyfried, P. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1985. 84p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE86750484.

Within the framework of the study possibilities of energy supply for a small redevelopment area with a very heterogenous building character were investigated. Proposals were worked out considering the relevant supply prerequisites and the restriction of the area surveyed. The saving potential of economic measures at buildings and heating technic as well as behaviour depending possibilities to save have been taken into account. Emphasis was put on such possibilities which could be incorporated into the redevelopment process contributing to the improvement of the energy supply and to the reduction of the dependence on fuel, and air pollution. By making use of all possibilities the heat requirements for the heating of living areas can be reduced by 30%. In the preparation of the draft it will be assumed realistic that a reduction of the consumption of primary energy of 15-24% after completion of the redevelopment (1990) as compared with 1981 can be achieved. The abridged version shows the results of the project. A detailed description of the procedural steps, methodology and results is given in four individual.

7377 **(BMFT-FB-T—85-089) Production staging development of a highly heat insulating, sound proofing and heat accumulating brick wall system with integrated heat accumulator (Combi-brick).** Flucke, B.; Granz, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1985. 165p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE86750497.

A stone, which represents the best compromise between the theoretical possibilities of heat insulation and accumulation as well as sound proofing and the practical conditions of brick production and manufacturing, has been developed. For this reason master gauges for hole bricks were at first designed according to existing experience and simple theoretical reflections, then produced in own brickworks and manufactured to trial masonries. The hole chambers were filled with different insulants and the trial masonries then went through various construction-physical examinations. By this, the best producing manufacturing formats as well as the most favourable combinations of master gauges for holes and insulants concerning construction-physical facts were found out.

7378 **(CONF-841231—) Research and development on heat pumps for space conditioning applications: proceedings of the DOE/ORNL Heat Pump Conference.** Jacobs, V.A.; Powell, R.H. Jr. (eds.). (Oak Ridge National Lab., TN (USA)). Aug 1985. Contract AC05-84OR21400. 269p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86002984.

From DOE/ORNL heat pump conference; Washington, DC, USA (10 Dec 1984).

This conference was planned to provide information on current activities in the US Department of Energy (DOE) and Oak Ridge National Laboratory (ORNL) Building Equipment Research (BER) Program. It was primarily for the benefit of HVAC equipment manufacturers and other interested parties, including utilities, independent research and development organizations, universities, other government groups, and research funding and management organizations. The technical presentations were grouped into two principal subject areas: electric systems and thermally activated systems. Electric-system topics included field performance studies, laboratory experiments on cycling performance, analytical estimates of the benefits of variable capacity and zone control, nonazeotropic refrigerant mixtures, ground-coupled systems, and an analysis of Stirling-cycle heat pumps. In the area of thermally activated heat pumps, presentations centered on the development of absorption systems, Stirling-engine-driven systems, and a linear, free-piston IC-engine compressor. Separate abstracts have been prepared for 27 presentations for inclusion in the Energy Data Base.

7379 **(CONF-8310110—4) Families and energy: ten years after the oil embargo.** Savitz, M.; Zuiches, J.J. (Michigan State Univ., East Lansing (USA)). 1983. Contract FG01-84CE24443. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003429.

From Conference on families and energy: coping with uncertainty; East Lansing, MI, USA (9 Oct 1983).

This report analyzes the effect that the oil embargo on family energy consumption over a ten year period. The results of the study on residential energy consumption and conservation are used to determine the research agenda for the next decade. (BCS)

7380 **(DOE/CE/15156—T1) [Office of State and Local Assistance Programs Management Support Services.] Final technical report.** (Arawak Consulting Corp., Arlington, VA (USA)). Dec 1985. Contract AC01-83CE15156. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003696.

The program management of the several task orders of the Office of State and Local Assistance Programs is briefly described. Budgetary information for each task order is included. (BCS)

7381 **(DOE/CE/15156—T2) [Weatherization Assistance Program].** (Arawak Consulting Corp., Arlington, VA (USA)). [1986]. Contract AC01-83CE15156. 221p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86003699.

The goal of the State and Local Assistance Program is to encourage energy conservation initiatives on the state and local level through a mix of activities and programs, including direct financial assistance, technical assistance, and developmental/demonstration projects to enhance state/private sector involvement in energy conservation. The Office of State and Local Assistance Programs administers the following programs: weatherization; schools and hospitals; EPCA grants; energy extension service; program evaluation; and program direction.

7382 **(DOE/CE/15156—T4) Replacement of GMIS by the DOE headquarters FMS. Feasibility study.** (Arawak Consulting Corp., Arlington, VA (USA)). 6 May 1985. Contract AC01-83CE15156. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86003700.

The purpose of this study is to determine the feasibility of replacing the current implementation of the Grants Management Information System (GMIS) with the DOE headquarters version of the Field Management System (FMS). The FMS provides DOE Support Offices with financial and procurement information on a grant-by-grant basis, as well as overall budget summaries by fiscal year and program. The GMIS provides the Office of State and Local Assistance Programs (OSLAP) with a system to organize and use data on the common information requirements of all six OSLAP programs.

7383 **(DOE/CE/15156—T5) Manufactured housing/ mobile homes weatherization resource guide .** (Arawak Consulting Corp., Arlington, VA (USA)). Mar 1985. Contract AC01-83CE15156. 144p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86003704.

This catalog represents an initial step by DOE's Weatherization Assistance Program headquarters office to assist in increasing the effectiveness of mobile home/manufactured housing weatherization. Information of three kinds is provided in this catalog: Section I - Summaries of state approaches to mobile home weatherization and any published materials used by state program staff. Section II - Abstracts and references for non-technical materials targeted for a general consumer population; and Section III - Abstracts and references for published research on the technical aspects of mobile home weatherization, including cost-effectiveness studies. These publications are available in most libraries.

7384 **(DOE/CE/15156—T6) WAP-related task orders.** (Arawak Consulting Corp., Arlington, VA (USA)). 1984. Contract AC01-83CE15156. 510p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE86003706.

Some related task orders for the weatherization assistance program are discussed. Topics include program evaluation, weatherization, monitoring, quality control and program management. (BCS)

7385 **(DOE/CE/15156—T11) Institutional Conservation Program. Participation Trends Study.** (Arawak Consulting Corp., Arlington, VA (USA)). Jul 1984. Contract AC01-83CE15156. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86003703.

The US Department of Energy (DOE) is authorized to administer the Institutional Conservation Program (ICP) under the National Energy Conservation Policy Act (NECPA) to implement multisector energy conservation grant programs aimed at assisting public and non-profit schools and hospitals, buildings owned by units of local governments and public care institutions. As part of the NECPA grants program, DOE awards matching grants to eligible institutions for the conduct of technical assistance (TA) analysis. The ICP Participation Trends Study provides an analysis of grant and funding levels for institutions that received matching grants for ECM. The study was developed to determine trends in various institutions according to a certain population areas, certain sizes of institutions, and from publicly or privately owned institutions. The purpose of this study is to support ICP policy analysis and potential modifications to program regulations and participation criteria.

7386 **(DOE/CE/15156—T12) [SLAP Programs: GMIS Program Manager's Guide].** (Arawak Consulting Corp., Arlington, VA (USA)). 1985. Contract AC01-83CE15156. 442p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE86003697.

The Office of State and Local Assistance Programs (SLAP) awards over $200 million annually in grants under a variety of legislated energy conservation programs. There is a single information system which addresses the rather narrow band of common information requirements, essentially financial, across all the SLAP programs. It is called the Grants Management Information System (GMIS). The objective of GMIS is to maximize the usefulness of existing data by organizing it to permit systematic analysis of potential problems as well as regular assessments of the financial status of State and Local Assistance Program grants. This volume, the GMIS Program Manager's Guide, is the first volume of the four volume GMIS User's Manual.

7387 **(DOE/CE/15156—T13) Field Management System (FMS) user's manual. Atlanta Support Office Phase I, Version ASO-2 .** (Arawak Consulting Corp., Arlington, VA (USA)). Jun 1985. Contract AC01-83CE15156. 380p. NTIS, PC A17/MF A01; 1; GPO Dep. File Number DE86003709.

This manual describes the Field Management System (FMS) designed for the Department of Energy Atlanta Support Office (ASO). This manual is written for both the FMS manager and the first-time computer user. The manual is written and FMS is designed so that these users can operate FMS without learning a lot about the computer operations. The chapters of this manual have been arranged so that selected chapters can be combined into separate manuals for the needs of each user. This arrangement is as follows: Data Inspection; Data Entry; FMS Maintenance; and FMS Manager.

7388 **(DOE/CS/20336—T2) Identification of category fourteen candidates.** (OAO Corp., Washington, DC (USA)). 29 Feb 1980. Contract AC01-79CS20336. 41p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003584.

In recognition of the need of the Nation to conserve energy and the responsibility of the Government to achieve this end, Congress has enacted the Energy Policy and Conservation Act (EPCA, PL 94-163), as amended by the National Energy Conservation Policy Act (NECPA, PL 95-619). These laws give the Secretary of Energy the mandate to prescribe energy efficiency standards for fourteen categories of energy-using consumer products. The Acts identify thirteen categories of appliances for which standards are required. In addition, DOE may identify any other type of consumer product (in "Category 14") for which energy efficiency standards may be promulgated. NECPA requires that DOE publish in the "Federal Register" a list of the consumer products selected to be included in Category 14 by November 1980. This study examines household consumer appliances to identify Category 14 candidates on the basis of the first two criteria listed above.

7389 **(EUR—9712-EN-IT) Bioclimatic design for building components and systems.** Zaccaria, G.; Los, S.; Pulitzer, N.; Tresca, A.; Zambelli, E.; Raitieri, R. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 381p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

The study presented is concerned with bioclimatic architecture, considered as a building system using current building production technologies. This represents an evolution beyond the past energy-bound concept of passive solar systems, restricted to specific devices and components. Demonstration of this thesis is pursued by an articulated method which entails the elaboration of the series of projects presented at the performance level, the analysis and verification of their energy efficiency using a computer simulation program, and finally, a technological formulation of the building systems. This method contains the following. Topics: 1. Performance system design, 2. Energy simulation and analysis, 3. Technological system design.

7390 **(EUR—9726-EN/DE) Internal combustion engine driven heat pump with a heating capacity of up to 20 kW.** Brockhoff, G.; Paulick, W. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 145p. (In German and English). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

The demonstration project showed the following positive and clarifying results: a) for the current fuel oil and natural gas price level the economy of the heat pump depends on the energy saving potential of the houses; most economical is the use in business buildings. b) Before the plants are launched into the market, final development work must be done, primarily the quality of the

obtained components must be distinctly improved; for the large volume production a cost-intensive incoming goods quality control must be made. c) Further certain development work is necessary to avoid any installation errors by the trade right from the start and thus to provide for well-priced installations. d) All 40 plants run satisfactorily; the targets of the demonstration project were achieved. e) The acceptance of the IC engine driven heat pump is exceptionally great, as was ascertained through contacts with companies, associations, authorities and installation firms, and also through a large number of interested house owners. Markets, distribution, sales and after-sales service are to built up carefully, considering all risks, in order to ensure the greatest possible safety for the sale and installation of the plants.

7391 **(EUR—9727-EN/DE) Heat pumps with absorber-type heat exchangers.** Jacobs, U. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 152p. (In German and English). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Contract No EE/205/80-DE was carried out in the framework of the demonstration programme in the field of energy saving and alternative energy sources. This project carried out by Energietechnik Essen demonstrates novel absorber-type heat exchangers using environmental heat for room heating purposes. Together with electrically driven heat pumps the absorber-type heat exchangers constitute heat supply systems replacing fuel oil by environmental heat and electricity. One multi-family building with eight dwellings is equipped with an "energy stack" of 220 m^2 absorber surface and a heat pump with a capacity of 48.5 kW. Also one single-family house is equipped with an energy fence of 43.2 m^2 absorber surface and a heat pump with a capacity of 10 kW. The report contains a detailed description of the plant and its control procedures as well as the results of monitoring during two heating periods. The economic viability of the demonstration and future mass-produced plants is described. Capital pay-back periods of approximately 6 years are expected for the commercial plants. The annual fuel oil substitution is 7.2 t for the multi-family building and 1.74 t for the single-family house at electricity consumptions of 28 200 kWh and 6 900 kWh.

7392 **(EUR—9851-EN) Insulated shutters.** Byberg, M.R.; Engelund Poulsen, K.; Rasmussen, N.H.; Solfeldt, H.S. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 70p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

In a single family house in Denmark about 35-50% of the total heat loss occurs through the windows. The main problem is the heat loss at night. This can be remedied by applying movable insulation in front of the windows. In this way the heat loss will be reduced and furthermore, also the cold draughts near the window. The project "Insulated Shutters" deals with internal insulated shutters for existing building and with shutters between two layers of glass for new building. Both types of shutters have been tested in a climate chamber and show considerable reduction of the transmission coefficient even for the double pane window when used at night. Thus the annual energy saving will be 900-1400 kWh for a typical Danish single family house with a window area of 20 m^2. The present day value method has been used for finding the maximum cost-effective investments. The analysis indicates that the internal shutter will have to have a lifetime of about 10 years to make the investment cost-effective and the shutter between the panes will have to have a lifetime of about 20 years. Furthermore, humidity tests have shown that under normal winter conditions there are no condensation problems. Under severe winter conditions the cold panes will steam up for a short time when the shutters are removed. The airtightness of the window element for new building is acceptable and that of the double glazed sealed unit is excellent independent of the shutters.

7393 **(K/CSD/TM—58) Use of roof temperature modeling to predict necessary conditions for locating wet insulation with infrared thermography.** Childs, K.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Nov 1985. Contract AC05-84OT21400. 45p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86004397.

In low-sloped roofing systems using porous insulation, the presence of water can significantly degrade thermal performance. For this reason, it is desirable to develop a reliable method for detecting the presence of water in a roofing system. Because of the different thermal characteristics of wet and dry insulation, there is often a surface temperature differential between areas containing wet insulation and areas containing dry insulation. Under the right circumstances, the areas of wet insulation can be detected by means of infrared sensing techniques. These techniques have already gained widespread acceptance, but there is still some uncertainty as to what are appropriate environmental conditions for viewing. To better define the conditions under which infrared techniques can distinguish between areas of wet and dry insulation, a one-dimensional, transient heat transfer model of a roofing system was developed. The model considers conduction through the roof, insolation on the surface, radiant exchange between the roof and sky, convective heat transfer between the roof and air, and the influence of trapped moisture on the thermal properties of the insulation. A study was undertaken using this model to develop an easily-applied technique for prediction of necessary conditions for locating wet roof insulation using infrared thermography.

7394 **(LBL—19383) Thermal analysis of buildings: configuration perturbations and observed climate interface.** Sullivan, R.; Huang, Y.J.; Bull, J.; Turiel, I.; Ritschard, R.; Selkowitz, S. (Lawrence Berkeley Lab., CA (USA)). Apr 1985. Contract AC03-76SF00098. 25p. (CONF-860106—1; EEB-W—85-06). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85014541.

From ASHRAE semi-annual meeting; San Francisco, CA, USA (19 Jan 1986).

Results are presented that indicate a proportional relationship between building thermal loads for varying configuration parameters. Through the use of numerous building energy simulations using both the DOE-2.1 and BLAST energy analysis computer programs, it is shown that the relationship is independent of climatic location and covers a broad spectrum of those variables that influence a building's energy use. The theoretical justification associated with such a phenomenon is treated using a multiple regression-derived algebraic expression that clearly establishes the linear independence of a building's heat gain/loss components. Procedures are defined for the simplification of future parametric studies of the thermal analysis of buildings using a methodology that incorporates the observations reported herein.

7395 **(NP—6770051) Practice of heat recovery.** (Fachinstitut Gebaeude-Klima e.V., Stuttgart (Germany, F.R.)). 1985. 70p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86770051.

58 second-generation HVAC systems are described. These systems may be found in office buildings, banks and building societies, industrial and commercial buildings, indoor swimming pools and winter-sport complexes, educational and research institutions, department stores, homes and hospitals. Each system is described. In addition, the special features of each are depicted and the annual financial and energy savings presented. References to the firms involved in planning and implementation round off the details given.

7396 **(NP—6770054) Selection of construction methods taking into account environmental conditions.** Olshausen, H.G.; Homes, J. (Bundesministerium fuer Raumordnung, Bauwesen und Staedtebau, Bonn (Germany, F.R.)). 1983. 327p. (In German). NTIS (US Sales Only), PC A15/MF A01. File Number DE86770054.

This research program aimed to look into and provide a comprehensive cross-sectional report on the environmental concerns affected by inner-urban building projects as well as their influence on the choice of construction methods used. The work starts off with the general complex of environmental problems in an

industrial society (environmental situation, system characteristics of and environmental relations in the building industry, environmental policy and its repercussions on the building industry, laws and regulations for the protection of the environment). From the socio-political and market management targets, aims and measures of environmental policy are then deduced and inferences made on the building industry (noise protection, vibration protection, avoidance of air pollutions, preservation of man's social and natural environment, protection of natural water reservoirs, conservation of raw materials and energy). This provides the basis for the subsequent analysis of construction underway in inner-urban building areas and for their impact on the environment. Possibilities for considering environmental concerns when selecting construction methods are discussed at the levels planning, contracts, and legislation.

7397 **(ORNL/M—104) Report Briefs.** (Oak Ridge National Lab., TN (USA)). Nov 1985. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003711.

Several brief reports on energy conservation systems are presented. Topics include heat pumps, double envelope buildings, roofing, absorption cycles, carpooling, and residential weatherization. (BCS)

7398 **(ORNL/M—105) Report Briefs on conservation and renewable energy.** Kuliasha, M.A.; Poore, W.P. (Oak Ridge National Lab., TN (USA)). Jul 1985. Contract AC05-84OR21400. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003039.

Report Briefs are presented on: Building Equipment, Building Envelopes, Retrofit Research, Evaluation and Modeling, Industrial Chemical Heat Pumps, and Electric Energy Systems.

7399 **(PNL—5382) User's guide for TRANZ: a data transformation and analysis program.** Fischer, K.J. (Pacific Northwest Labs., Richland, WA (USA)). Dec 1985. Contract AC06-76RL01830. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86004234.

This report is a user's guide for TRANZ, a program developed by Pacific Northwest Laboratory (PNL) for an IBM PC with a basic compiler, Version 2.0. The purpose of TRANZ is to convert, organize, and evaluate electrical end-use load data obtained from the Field Data Acquistion Systems (FDAS). These FDAS will be installed in commercial buildings and residence as part of the End-Use Load and Conservation Assessment Program (ELCAP) that is being managed by PNL for the Bonneville Power Administration (BPA). TRANZ has been developed with highly interactive menu-driven routines and requires little computer experience for proper operation. It is executable on a single or double disk drive IBM PC. The program can be used for spot checking data, troubleshooting installation problems, and preparing tabular and graphical summaries. Sample files and program output, and a program source code listing are provided as appendices. The program itself contains six primary routines: The first routine converts the raw character byte data dumped from the FDAS into a formatted ASCII engineering unit file. The second routine checks the data to make sure that each value is within a reasonable range. The third routine sorts a file so that the records start at the earliest time and end at the latest time. The fourth routine appends two files for the same building or residence, removing any overlap in the files. The fifth routine summarizes the data in both a tabular and graphical form. The sixth routine generates a hard copy table of day numbers and their corresponding dates.

3202 TRANSPORTATION

REFER ALSO TO CITATION(S) 7397, 7422, 7423

7400 **(CONF-860113—2) High occupancy vehicle lanes: some evidence on their recent performance.** Southworth, F.; Westbrook, F. (Oak Ridge National Lab., TN (USA); Camden Corp., McLean, VA (USA)). Sep 1985. Contract AC05-84OR21400. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86002236.

From 65. annual meeting of the Transportation Research Board; Washington, DC, USA (20 Jan 1986).

The results of a 1985 survey of HOV lane project performance are presented. Despite the lack of the energy crises that spurred HOV lane promotion during the seventies, HOV lane planning has continued to remain active in a number of states. Most currently, operational mainline HOV lanes were found to be very effective as people movers during commuting rush hours, and to save fuel by removing significant numbers of automobiles from the road through high levels of ridesharing and bus patronage. Bus ridership has managed to compete effectively with carpooling/vanpooling on a number of lanes. Continued traffic growth during the eighties is strengthening the case for HOV lane use in many big city urban corridors.

7401 **(DOE/NBB—0073) Motor Fuel Consumption model. Eleventh periodical report.** (Environmental Protection Agency, Ann Arbor, MI (USA)). Sep 1985. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86003875.

The purpose of this report is to acquaint the reader with the most current output of the Motor Fuel Consumption model and to discuss revisions in the model structure, input data and assumptions which have occurred in the past year. The report is briefly summarized in Section 2. Section 3 presents the current projection of motor fuel consumption, and compares it to the one used in the preceding report of this series. Section 4 describes recent activities involving the use of the model. A description of the basic model structure and methodology is presented in Appendix A. Copies of the October 1984 output of the model are attached in Appendix B and Appendix C.

7402 **(ORNL/TM—9329) Data source compendium of non-residential transportation energy use.** McGill, R.N.; Holcomb, M.C. (Oak Ridge National Lab., TN (USA)). Nov 1985. Contract AC05-84OR21400. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86003005.

Considerable information is collected and known concerning residential transportation energy use from currently existing surveys. Energy use data in the non-residential transportation sector, however, cover a broad spectrum from very good, reliable data to virtually non-existent data. Objective of this report is to identify and evaluate the sources of data that relate to energy end use in the non-residential transportation sector. The compendium lists data sources, level of detail, frequency of publication, time between data occurrence and data availability, and the probability of continued publication. In addition, to the extent possible, quality of the data is assessed. All modes of the non-residential transportation sector - highway, air, rail, marine, pipeline, and military - are covered in this study. Exhibits of all tables from the various data sources, showing energy consumption estimates or other data from which energy use may be derived, are included with the discussion of the mode. For the modes of transportation that are the most regulated, a significant amount of data are available. Conversely, for those areas or modes where there is no regulation and the industry, itself, is rather disjointed, there may always be a dearth of data or information.

3203 INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 7066, 7067, 7068, 7073, 7075, 7078, 7125, 7322

7403 **(ANL/CNSV—49) Implications of proposed acid-rain legislation for use of carbon dioxide from electric utilities for enhanced oil recovery.** Cobb, T.B.; Streets, D.G.; Veselka, T.D.; Woisky, A.M. (Argonne National Lab., IL (USA)). Oct 1985. Contract W-31-109-ENG-38. 107p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86003982.

This report describes the effect of proposed acid-rain legislation on the economics of CO_2 recovery from fossil-fired electric-power plants. The proposed legislation would require reduced emissions of SO_2. The cost of reducing emissions could be avoided by recovering SO_2 with CO_2 and selling the mixture (practically all CO_2). After prorating on the basis of units of CO_2/SO_2 mixture recovered, one could consider this avoided cost to be a credit for

acid-rain cleanup. Estimates of this CO_2 credit are presented in this report.

7404 **(BMFT-FB-T—85-082) Reduction of copper containing slags in contact with high grade matte by top-blowing of methane/oxygen- and coal/air-mixtures.** Steinhauser, J.; Wuth, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1985. 48p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE86750489.

The report describes the reduction of copper containing slags by top blowing technique. Slag/matte systems and slag/copper systems were investigated. The application of mixtures of oxygen/methane, air/hardcoal and air lignite (fossil reductants) as well as copper concentrate and pyrite (non fossil reductants) was studied. Raw materials for the melt system are a complex copper concentrate and smelter products (matte, slag). Velocity constants are given for the decoppering of the slag phase. The final status of the matte phase and the slag phase after the reduction are described. The distribution of the impurities of lead, zinc, bismuth, antimony, arsenic, cobalt, nickel and selen after the reduction towards the different phases was measured. Distribution coefficients are plotted as a function of the matte grade.

7405 **(BMFT-FB-T—85-101) Trials to reduce energy cost by firing tiles in a roller kiln operating on a roll-rod-system.** Albrecht, W.; Gunten, F. von; Kruse, B.D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Sep 1985. 38p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE86750496.

With 3 refs., 3 tabs., 5 figs. .

For the second firing of wall tiles a roller kiln was reconstructed to a kiln system operating with rolls as well as rods. Hereby, priority was given to the reduction of energy cost. The product quality should not be lower obtained in conventional kilns. A roll-rod kiln works on the principle that tiles are transported on rods through the kiln having only about 25 p.c. of rolls compared with a normal roller kiln. This conveying system permits an optimum of heat transfer with regard to the high transit velocity without losing the high quality standards, (i.e. overglazed edges, no damage of edges etc.). A suitable and reliable plant for the rod circulation and for the loading and unloading of tiles was constructed. The problem to find construction materials for the rolls and rods could be solved by using suitable heat-resistant steel. The firing time could be shortened to about 30 minutes and the specific energy consumption could be reduced to about 1.700 kJ/kg (gross, without heat recovery).

7406 **(DOE/CS/40402—T5) DRAFT NAM/DOE Energy Manual.** (Centec Consultants, Inc., Reston, VA). 23 Aug 1985. Contract AC01-80CS40402. 178p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86002290.

This manual is intended for use by the staff and managers of manufacturing operations, and to provide background for starting, continuing, and auditing an energy management program. Two main topics are covered: energy program organization and industry-wide energy conservation technologies. Energy program organization covers personnel, objectives, accounting, and auditing. It provides an outline for the management activities required. The energy technologies topic covers general energy conservation and many specific techniques for improved efficiency. Practices have been selected that have wide application. Sufficient information is developed so that the economics of a particular application can be estimated.

7407 **(DOE/R1/10392—T1) [Heat utilization at a commercial laundramat].** (Saunders and Sons Enterprises, Westerly, RI (USA)). [1985]. Contract FG41-80R110392. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000339.

An EPDM rubber tube mat (trade name - Sola Roll) was used as a heat exchanger to trap heat being vented through the dryer exhaust pipes at the Friendship St. Laundramat. Results of studies are presented. A savings of 54.4% on fuel oil usage was obtained during a full year's trial of the system. The waste heat was used to heat water for the washing machines. 5 figs., 1 tab. (DMC)

7408 **(EUR—9010) Recuperation of energy in a catering type dishwasher by means of a heat pump.** Schoeffler, G. (Commission of the European Communities, Luxembourg). 1984. 43p. (In French and English). Commission of the European Communities, Luxembourg.

The operation of catering type dishwashers consumes a lot of electricity, particularly to heat the water used for washing and rinsing of the dishware, and to keep it at the proper temperature level. A heat pump as an energy recovery device seems to be interesting for reducing the electricity consumption. The aims of the project were the study and realisation of a heat pump adapted catering type dishwasher, the measurement of performance and energy consumption of a conventional type dishwasher and of the same dishwasher equipped with a heat pump for heat recovery from the vapour in the machine, as well as the comparison of the results of the two measurement programmes. The report contains a description of the installation, the performance measurements, the difficulties encountered, and the commercial prospects. The comparison with a dishwasher without heat pump indicates that the annual energy consumption for the complete operation of the machine was reduced by 41.5%, i.e. 35,172 kWh/year.

7409 (Juel-Spez—297, pp 159-172) **Evaluation of the performance of a combined heat pump and thermal energy storage heating systems.** Buick, T.R.; Cohen, R.R.; O'Callaghan, P.W.; Probert, S.D.; Smith, I.E. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

Short term thermal energy storage using phase change materials is shown to be a viable means of improving the transient performance, system matching, and user acceptance, of heat pumps for domestic heating. Any improvement in the economics of such a system is likely to be slight, even though thermal energy storage permits maximum advantage to be made of reduced tariff periods.

7410 (Juel-Spez—297, pp 173-183) **Paraffin heat storage in combination with heat pumps.** Dubois, P.; Berthet, M. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

A paraffin heat store can be used in combination with a heat pump in order to save more energy and to shift a part of the electricity consumption from higher to lower tariff hours. After doing research on cheap and efficient paraffin packaging and on heat transfer kinetics, we have designed, built and tested a store containing 0.9m^3 of paraffin. Based on the results of these tests, we present conclusions on the economic interest for space heating of a heat store and heat pump combination.

7411 (Juel-Spez—297, pp 199-211) **Comparison of energy storage systems in the United States chilled water versus two types of ice storage systems.** Fischer, H.C. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—). Contract AC05-84OR21400.

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

Current U.S. production non-storage heat pumps are compared to heat pumps using stored hot water and stored chilled water and to heat pumps using ice-on-coils as a means of using latent heat of fusion of water as a heat source. This equipment is also used as a means of stored cooling for air conditioning during hot weather. An ice-making heat pump which harvests ice as sheets of ice 3 to 4 times per hour and stores the ice in a large inexpensive bin is discussed. The advantage of such an ice-making heat pump to heat in cold weather and cool in hot weather is discussed as it relates to Electric Utility load management in different parts of the United States.

7412 (Juel-Spez—297, pp 219-230) **Assessment of nonlatent heat storage technologies for industrial applications.** Melikian, G.; McChesney, H.R. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

An analytical assessment has been carried out to determine the role of thermal energy storage (TES) in the recovery and utilization of industrial waste heat. A major feature of this assessement was the characterization of energy recovery and TES technologies. Specific TES applications were selected using detailed process data obtained from on-site plant visits to selected industries. Proposed waste heat recovery and utilization systems were designed and optimized using a computer model and an equipment data base to obtain the maximum rate of return (ROR) on investment and displacement of fossil fuel for each application. The economic benefits, net energy savings and applications having after-tax on ROR $>$ 20 percent. Nine of these systems utilize TES.

7413 (Juel-Spez—297, pp 231-241) **Commercialization of 50 kWh PCM store for industrial applications.** Erma, E. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

The development of a 50 kWhsub(th) LHS-module by Alfa-Laval was based on studies of the Linkoeping Institute of Technology, which showed, that within the frame of industrial low-temperature heat recovery, LHS can play an important role. The investment cost (including installation) of about 350 SEK/kWhsub(th) imply a pay-back time of 7 years if the LHS can be used 200 times/year. Realistic cost extrapolations for larger series production lead to about 250 SEK/kWhsub(th) and, consequently, to about 5 years pay-back time.

7414 (Juel-Spez—297, pp 242-260) **Climatization of industrial premises by use of short term storages.** Johansson, T.; Solmar, A. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

As an example of industrial short time energy storage an application in a bakery is presented. The energy use in a bakery is dominated by the supply of heat to the ovens. After the baking process about 65% of the energy supply to the oven is found as sensible heat in the bread, plates and car. This waste heat, which can be recovered during cooling gives a surplus of low temperature energy during production hours. By means of energy storage the surplus heat can be used for heating of the premises during non production hours. A full scale PCM energy storage has been used in a Swedish bakery to test this idea.

7415 (Juel-Spez—297, pp 261-270) **PCM heat storage for industrial energy cascades.** Soederstroem, M.F.; Karlsson, B.G. Feb 1985. NTIS (US Sales Only), PC A14/MF A01. File Number DE86750490. (CONF-8403146—).

From IEA workshop on latent heat stores - technology and applications; Stuttgart, F.R. Germany (7 Mar 1984).

In many cases the recovery of process surplus heat to supply another process is impossible without the use of an energy storage. Latent heat storage is advantageous in energy cascading applications because of the requirements for certain temperature levels and the limitation of temperature differences. The processes power characteristics are of a stochastic nature. Thus each source-sink relation has to be analyzed separately. A simple technique is used here to evaluate the need for and the size of energy storage units. Some criteria e.g. charging power and discharging temperature have to be satisfied. In one application in a heat treatment shop the need for non-simultaneousness and supply reliability storage is evaluated. In this case a latent storage with a melting temperature of 105°C and a storage material volume of 0.16 m^3 is chosen.

7416 (NMAB—429-1) **Assessment of the Industrial Energy Conservation Program: FY 1985 and planned FY 1986.** (National Materials Advisory Board (NRC), Washington, DC (USA)). 1985. Contract AC01-84CE40625. 48p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003171.

This report examines and evaluates the US Department of Energy's Industrial Energy Conservation Program for fiscal year 1985. It also contains an assessment of the distribution of projects undertaken by the Office of Industrial Programs (OIP) to determine (1) whether there was a satisfactory balance between shorter term and longer term objectives; (2) whether there was an appropriate sequencing and flow of projects from year to year; (3) the interfaces between OIP and other related federal and industrial programs; and (4) the role of the federal government in industrial energy conservation. The participation by industry in OIP's efforts, particularly through industrial cost-sharing of R and D projects, is examined as a critical measure of the relevance of a project to the needs of industry.

7417 (NP—6770044) **Closed greenhouse systems with integrated solar desalination plant for water designed to be used in arid zones.** Strauch, K.H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Mar 1985. 250p. (In German). NTIS (US Sales Only), PC A11. File Number DE86770044.

Two experimental greenhouses are used as test cases to develop a concept for closed greenhouses for arid lands, which is described in this work. The aim is to include in the building a solar desalination plant for water as an integral part. The concept is essentially characterized by the use of current profiles and materials, avoidance of water losses due to exchange of air and recovery of the water passing from the plants into the completely closed atmosphere owing to evapotranspiration as an element for establishing a positive water balance of the overall system. A computer program which has been developed is used to describe the behaviour of the closed greenhouse system with due consideration of the climatic conditions at the site, Sede Boqer (Israel). The work shows the effect of uncontrolled air exchange on the water balance of the system and the impact of different modifications designed to exert a positive influence on the energy balance.

3206 MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 7376

7418 (BMFT-FB-T—85-093) **Wastes and environment-assessments of the net environmental impacts of waste management and waste technologies.** Sillah, O.; Bergmann, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1985. 134p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE86750493.

Due to the big increase of solid waste quantities, the waste utilization and disposal capacities must be permanently adapted. The objectives of this study are to assess the effects on the environment of solid waste management and technologies in the Federal Republic of Germany (collect and transport, disposal in landfills, incineration, pyrolysis, refuse derived fuel, biogas production, resource recovery). While the purification of leachate from landfills makes some difficulties, the environmental impacts of thermal technologies (e.g. incineration and pyrolysis) consist of emitted particulates within the smoke gas. In spite of increasing thermal waste treatment facilities, the effects on the environment of waste technologies represent only a very small part of the whole environmental impact.

7419 (BNL—36740-R) **Handbook of district heating and cooling models.** Reisman, A.W. (Brookhaven National Lab., Upton, NY (USA)). May 1985. Contract AC02-76CH00016. 309p. NTIS, PC A14/MF A01; GPO Dep. File Number DE86003508.

In response to recent renewed interest in district heating and cooling (DHC) in the United States, consultants, city planners, and

engineering firms have begun to search for existing models which might help identify and analyze new DHC projects. The United States Department of Energy (DOE), aware of the need to inform potential users of the existence of the public domain models developed under DOE sponsorship, has provided funds to Brookhaven National Laboratory (BNL), Upton, New York to produce this Handbook. In addition, the International District Heating and Cooling Association (IDHCA) has agreed to print and distribute the Handbook under its auspices, thus ensuring a wide audience in the district heating and cooling industry. At IDHCA's suggestion, the scope of the Handbook was expanded to allow inclusion of proprietary as well as public domain models.

7420 **(DOE/R2/05048—T1) Energy efficiency in suburban development.** (Llewelyn-Davies Associates (USA); Buckhurst Fish Hutton Katz (USA); Flack and Kurtz, New York (USA)). 20 Oct 1980. Contract FG42-79R205048. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86000498.

The report highlights the consultant study on the development of land use guidelines for maximizing energy efficiency in suburban development. The study involved the following work components: a brief analysis of the existing land use relationships and transport systems that impact on energy utilization and consumption within the Township as a whole; a review of possible land use and urban design elements and relationships that could be applied to both infill development and new construction in South Brunswick; and preparation of development criteria relating to energy conservation in the form of planning guidelines, zoning modification or other forms of development control pertinent to the Township.

7421 **(NP—6770046) Marketing and selling in electric power stations and the electric societies.** Leiner, W. (Energie-Versorgung Schwaben A.G., Stuttgart (Germany, F.R.)). 1984. 89p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE86770046.

Marketing electric utilities and selling them appear, at first sight, to have little to do with the functioning of electric power stations. The latter have come under constant fire since they have carried out their work solely with an eye to profit. This book looks at the reasons which have led to an acceptance of the advertising and commercial function, and shows that their main concern was to have a means of raising and controlling the sale of electricity. These means have been employed by the management to fulfill their legal mandate to supply electricity as safely and as cheaply as possible. The fact that electricity is no longer regarded as a luxury good and has managed to retain stable prices over a long period of time, can be attributed to the extensive use of these means of control.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 7064

7422 **(DOE/PE/70045—2) Reconciliation of differences in the results of published shortfall analyses of 1981 model year cars.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Oct 1985. Contract AC01-78PE70045. 89p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86003876.

Purpose of the analysis would be to review the differences in data, analysis approaches, results and conclusions in the four papers presented in the 1982 SAE meeting and to identify the areas of consensus and genuine disagreement. There is a diversity of data sources and analysis techniques, as well as considerable inconsistency in the reporting of the procedures employed in each study. Some of the apparent differences are easily reconciled. For example, some analysts evaluated shortfall (failure to achieve EPA mpg rating on the road) in gallons per mile (GPM) space while others employed gallons per mile ratio (GPMR) space; the obvious resolution is to replicate the analyses in the same measurement space. Many of the differences, however, are not as easily resolved. Some data sources have a seasonal bias toward the time of year most advantageous to fuel economy performance. Other data sources are claimed to be representative of annualized driving, but the claims are not substantiated by information on the seasonal distribution of the data. Thus, the inquiry must consider the comparability of the papers' data sources and the representativeness of each for measuring consumer fuel economy. The approach employed is first to conduct a consistent review of the data, analysis procedures, results and conclusions presented in each of the papers. Following this review, papers exhibiting the most significant differences from the DOE analysis are selected for a detailed methodological critique and review of empirical results. That critique is organized into four categories: (1) overall 1981 shortfall; (2) the dependence of shortfall on the EPA Composite mpg rating; (3) the dependence of shortfall on vehicle technology; and (4) trends in model-year shortfall levels.

7423 **(DOE/PE/70045—T25) Revised projections of fuel economy and technology for highway vehicles. Final report.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Oct 1985. Contract AC01-78PE70045. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86003772.

In earlier work performed for the DOE, EEA has analyzed technological trends in cars, light-duty trucks (LDT), and heavy-duty trucks (HDT). The technological analysis was used to forecast fuel economy for the three vehicle classes. In this report, EEA has updated both the methodology used to forecast fuel economy as well as the technological and tooling plan data central to the derivation of the forecast for all those vehicle classes. Forecasts were prepared for a scenario where oil prices stay flat through 1985 (in current real dollars) and increase at the rate of two % per year in the 1985 to 1995 period. This report also documents EEA's estimates of the mix of vehicles sold and projections for diesel penetration.

3303 ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 7109

3304 HYBRID SYSTEMS

7424 **(CONF-860119—1) Electric/hybrid vehicle model for establishing optimal battery requirements.** Marr, W.W.; Walsh, W.J. (Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001791.

From Society for Computer Simulation (SCS) multiconference; San Diego, CA, USA (23 Jan 1986).

This paper describes a microcomputer program (HELEN) for establishing battery requirements for a heat engine/battery hybrid vehicle. The program enables least-cost analyses to identify the optimum combination of battery and heat engine characteristics for different vehicle types and missions. It can also be used for cost comparisons between heat-engine vehicles, all-electric (battery) vehicles, and hybrid vehicles. Simplified models are used for the transmission, motor/generator, controller, and other vehicle components, while a rather comprehensive model is employed for the battery. The heat engine performance model is based on engineering data for a production engine. A series/parallel configuration for the hybrid vehicle system is presently simulated. Energy management in the operation of the vehicle depends on the specified mission requirements, type and size of the battery, allowable battery depth of discharge, type and size of the heat engine, and the energy management strategy used. The program is written in PL/I language and can be run interactively on an IBM PC, COMPAQ, or other compatible microcomputer.

3307 EMISSION CONTROL

7425 **(DOE/NASA—0290-1) Combustor flame flashback.** Proctor, M.P.; T'ien, J.S. (Case Western Reserve Univ., Cleveland, OH (USA)). Jun 1985. Contract AI01-77CS51040. 80p. (NASA-CR—174961). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86003906.

Premixed-prevaporized combustors operate with uniformly lean fuel/air ratios and consequently produce lower emission levels of NO/sub x/ and soot than diffusion flame combustors. For this reason, they are candidates for advanced automotive and aircraft gas turbines. Flashback, a problem that occurs in premixed-prevaporized combustors, is the upstream propagation of the flame from the combustor into the premixing tube. Not only does flashback change the combustion process from premixed burning to diffusion burning, thus creating more pollutants, but it also inflicts considerable damage on the fuel injector, premixing tube and other equipment upstream. Therefore, before implementing the premixed combustor, an understanding of the flashback mechanisms should be achieved and a scheme for preventing its occurrence has to be found.

3308 ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 7064, 7065, 7067, 7068

7426 **(NZERDC—113) Technical survey of CNG vehicles.** Jones, K.; Raine, R.R.; Stephenson, J. (Auckland Univ. (New Zealand). Dept. of Mechanical Engineering). Feb 1985. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86900270.

This report describes the findings of a non-random selection survey undertaken to assess the performance standard and level of public satisfaction with CNG powered vehicles. A total of 65 vehicles from the Auckland area was evaluated covering most of the popular models and CNG conversion systems. A significant proportion was found to have CNG equipment deficiencies which caused a power difference between petrol and CNG of more than 20%. The majority of these vehicles were capable of being rectified relatively easily. Approximately 75% of the people surveyed were satisfied with the power output of their vehicle. Over half of the vehicles belonging to dissatisfied owners exhibited power differences in excess of 20%. The major complaint, raised by over 25% of the people surveyed, was difficult cold starting on CNG.

36 MATERIALS

7427 **(CONF-850887—43) Novel characterization of thin film multilayered structures: microcleavage transmission electron microscopy.** Lepetre, Y.; Schuller, I.K.; Rasigni, G.; Rivoira, R.; Philip, R.; Dhez, P. (Argonne National Lab., IL (USA); Aix-Marseille-3 Univ., 13 - Marseille (France); Laboratoire pour l'Utilisation du Rayonnement Electromagnetique (LURE), Paris-11 Univ., 91 - Orsay (France)). Jul 1985. Contract W-31-109-ENG-38. 7p. NTIS, PC A02. File Number DE85018373.

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

Microcleavage Transmission Electron Microscopy has been applied to the study of many properties of multilayered samples. We illustrate the unique capabilities of this technique to study long range perpendicular thickness drifts, lateral variations, roughness, substrate quality and island structures.

7428 **(UCID—18574-84-4) Materials Physics quarterly report, October-December 1984. H Division.** (Lawrence Livermore National Lab., CA (USA)). Aug 1985. Contract W-7405-ENG-48. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86002901.

The following were studied: phase transition in fluid nitrogen at high densities and temperatures, recovery of shocked Nevada tuff to 1.2 Mbar, high pressure studies on Nd using diamond-anvil apparatus, pressure dissociation of solid nitrogen under 1 Mbar, liquid scaling equation of state revisited, test of 3d transition metal pair potentials in the T=0 solid, heat flow in solids, flow instabilities in liquid propellant combustion, and the effect of compliant material response on Tollmein-Schlichting instability growth rates.

7429 **Grain impingement during recrystallization.** Price, C.W. (Chemistry and Materials Science Division, Lawrence Livermore National Laboratory, University of California, Livermore, CA). *Scripta Metallurgica;* **19**: No. 6, 785-788(Jun 1985).

The spherical computer model based on a cubic array of spheres growing at the same rate with the same radius is an obvious oversimplification of recrystallization reactions. However, it does provide calculable impingement geometry, and it yields results that are in agreement with experimental results. The model supports the use of a parabolic relation, although it emphasizes the empirical nature of the relation and demonstrates limitations of the relation at $f = 0$ and $f = 1$. The results generated by the model further indicate that computer models of regular geometric solids can provide useful information on grain impingement during recrystallization reactions.

3601 METALS AND ALLOYS

REFER ALSO TO CITATION(S) 6905, 7104, 7104, 7173, 7174, 7175, 7199, 7273, 7485, 7495, 7523, 7589, 7640, 7640, 7670, 8134

7430 **(AD-A—155629/9/XAB) Fracture in liquid metal environments. Final technical report.** Kamdar, M.H. (Army Armament Research and Development Command, Watervliet, NY (USA). Large Caliber Weapon Systems Lab.). Apr 1985. 63p. (ARLCB-TR—85013). NTIS, PC A04/MF A01.

From 6. international fracture conference; New Delhi, India (4 Dec 1984).

Many ductile metals fracture in a brittle manner when tested in the presence of a thin surface coating of certain liquid metals. The severity of embrittlement depends upon the metallurgical, mechanical, and physical factors and also on the chemical nature of the liquid and the solute dissolved in the liquid metals. Liquid metal embrittlement is considered a special case of brittle fracture and it is generally accepted that embrittlement is caused by the liquid metal Adsorption Induced Reductions in the Cohesion of atomic bonds at the crack tip. This report describes the phenomena of fracture in liquid metal environments and discusses the effects of variables related to the solid, the liquid, the liquid metal solutions, and to the test conditions on the severity of embrittlement. It also discusses various mechanisms of embrittlement. Also, a summary with suggestions for future work is presented.

7431 **(BNL—36993) Applications of current measurement over corroding metallic surfaces.** Isaacs, H.S. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 8p. (CONF-8508137—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001174.

From Ionic currents conference; Los Angeles, CA, USA (2 Aug 1985).

The scanning vibrating probe has been used to study a number of different corrosion related systems: aluminum and iron pitting, metallic and organic coatings, pitting and crevice corrosion of stainless steels and stress corrosion cracking. A few examples are presented to illustrate the technique.

7432 **(BNL—37094) Modeling effects of thin film formation at crack tips on fracture.** Sieradzki, K. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 18p. (CONF-8510168—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001180.

From TMS/AIME fall meeting; Toronto, Canada (13 Oct 1985).

This paper discusses the manner in which thin films surrounding cracks can induce deformational mode transitions in materials. That is cracks which normally deform by dislocation emission can be made to cleave (and vice versa) by "coating" the crack surfaces with films of appropriate properties. Such films actually form on metallic crack surfaces in certain environments and lead to the

phenomenon known as stress-corrosion cracking. Analytical calculations are presented and the results indicate that the important parameters influencing deformational mode transitions include elastic modulus, film-substrate lattice parameter mismatch, film thickness, and interfacial bond strength.

7433 **(BNL—37168) Quasicrystalline structures of transition metal/metalloid glasses.** Watson, R.E.; Bennett, L.H. (Brookhaven National Lab., Upton, NY (USA); National Bureau of Standards, Washington, DC (USA)). 1985. Contract AC02-76CH00016. 9p. (CONF-850890—24). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002932.

From International conference on magnetism; San Francisco, CA, USA (26 Aug 1985).

The Wigner-Seitz method has been used to specify the "near-neighbor" environments in glass-forming TM crystalline phases, where T = Cr, Mn, Fe, Cu, Ni and M = P, B, Si. The crystal structures fall into different topological classes which may well account for the polymorphism in the glasses.

7434 **(BNL—37171) Topology of local atomic environments: implications for magnetism and superconductivity.** Bennett, L.H.; Watson, R.E.; Pearson, W.B. (National Bureau of Standards, Washington, DC (USA); Brookhaven National Lab., Upton, NY (USA); Waterloo Univ., Ontario (Canada). Dept. of Physics). 1985. Contract AC02-76CH00016. 9p. (CONF-850890—25). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002933.

From International conference on magnetism; San Francisco, CA, USA (26 Aug 1985).

Wigner-Seitz cells have been constructed, as a function of atomic size, for a number of transition-metal alloys ($SmCo_5$ etc.) and a disclination network has been obtained from these. Magnetism in these alloys can be related to the disclination lines, much like the superexchange paths familiar in the magnetism of salts.

7435 **(BNL-NUREG—37001) Electrochemical and metallurgical aspects of stress corrosion cracking of sensitized Alloy 600 in simulated primary water containing sulfur contamination.** Bandy, R.; Kelly, K. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 13p. (CONF-850902—8). NTIS, PC A02/MF A01 - GPO. File Number TI86002510.

From 2. international symposium on environmental degradation of materials in nuclear power systems--water reactors; Monterey, CA, USA (9 Sep 1985).

The stress corrosion cracking (SCC) of sensitized Alloy 600 was investigated in aerated solutions of sodium thiosulfate containing 1.3% boric acid. Results indicate that in the borated thiosulfate solution containing 7 ppM sulfur, 5 ppM lithium as lithium hydroxide is sufficient to inhibit SCC in U-bends. The occurrence of inhibition seems to correlate to the rapid increase of pH and conductivity of the solution as a result of the lithium hydroxide addition. In the slow strain rate tests in the borated solution containing 0.7 ppM lithium as lithium hydroxide, significant SCC is observed at a sulfur level of 30 ppB, i.e., a lithium to sulfur ratio of 23. In a parallel test in 30 ppB sulfur level but without any lithium hydroxide, the SCC is more severe than that in the lithiated environment. In the constant load test on a specimen held initially at a nominal stress near the yield strength of the material, cracks continue to grow until fracture during controlled, progressive dilution of the bulk solution, leading to final lithium concentration of 1.5 ppM and sulfur concentration (as thiosulfate) of 9.6 ppB i.e., a lithium to sulfur ratio of about 156, although lithium hydroxide retards the rate of crack propagation to some extent. The crack growth rate is strongly influenced by the electrochemical potential which is primarily governed by the local crack tip chemistry.

7436 **(CONF-8508146—1) Effects of cavitation on high-cycle fatigue life.** Majumdar, S. (Argonne National Lab., IL (USA)). Sep 1985. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001814.

From Minnowbrook conference on life prediction for high temperature gas turbine materials; Blue Mountain Lake, NY, USA (27 Aug 1985).

Cavitation was measured in 304 stainless steel after creep tests. Results show that cavitation is highly inhomogeneous. This has a significant effect on the interaction between small amounts of creep damage and high-cycle fatigue life. The low-cycle creep-fatigue and the high-cycle fatigue are not independent and may have large interactive effects. (DLC)

7437 **(CONF-8509204—1) Cyclic stress-strain-time response of a 9Cr-1Mo-V-Nb pressure vessel steel at high temperature.** Swindeman, R.W. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003317.

From Symposium on low cycle fatigue-directions for the future; Bolton Landing, NY, USA (30 Sep 1985).

Data are presented that describe the behavior of a 9Cr-1Mo-V-Nb steel under conditions of constant and cyclic loading at temperatures from 25 to 600°C. The general features of hardening under monotonic and cyclic strains are presented and discussed in regard to the selection of the cyclic hardening curve most suitable for design applications. Creep data for temperatures in the range 500 to 650°C and times to 10,000 h are presented and correlated by a creep law that is applicable in the primary and secondary creep stages. Simple rules for hardening and recovery are postulated and used to estimate the time dependent behavior after mechanically and thermally induced reversal strains. Data from relaxation, partially restrained creep, and two-bar creep ratchetting experiments are presented, and the estimated response is compared to the test data. It is shown that simple concepts of strain hardening and reversed strain softening are adequate for estimating the material behavior under most of the loading conditions that were examined.

7438 **(CONF-8510160—7) Energy deposition, heat flow, and rapid solidification during laser and electron beam irradiation of materials.** White, C.W.; Aziz, M.J. (Oak Ridge National Lab., TN (USA)). Oct 1985. Contract AC05-84OR21400. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86002240.

From ASM metals congress - international conference on surface modifications; Toronto, Ontario, Canada (13 Oct 1985).

The fundamentals of energy deposition, heat flow, and rapid solidification during energy deposition from lasers and electron beams is reviewed. Emphasis is placed on the deposition of energy from pulsed sources (10 to 100 ns pulse duration time) in order to achieve high heating and cooling rates (10^8 to 10^{10} °C/s) in the near surface region. The response of both metals and semiconductors to pulsed energy deposition is considered. Guidelines are presented for the choice of energy source, wavelength, and pulse duration time.

7439 **(CONF-8510173—25) Aging degradation of cast stainless steel.** Chopra, O.K.; Chung, H.M. (Argonne National Lab., IL (USA)). Oct 1985. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01 - GPO. File Number TI86003068.

From 13. water reactor safety research information meeting; Gaithersburg, MD, USA (22 Oct 1985).

A program is being conducted to investigate the significance of in-service embrittlement of cast-duplex stainless steels under light-water reactor operating conditions. Data from room-temperature Charpy-impact tests for several heats of cast stainless steel aged up to 10,000 h at 350, 400, and 450°C are presented and compared with results from other studies. Microstructures of cast-duplex stainless steels subjected to long-term aging either in the laboratory or in reactor service have been characterized. The results indicate that at least two processes contribute to the low-temperature embrittleent of duplex stainless steels, viz., weakening of the ferrite/austenite phase boundary by carbide precipitation and embrittlement of ferrite matrix by the formation of additional phases such as G-phase, Type X, or the α' phase. Carbide precipitation has a significant effect on the onset of embrittlement of CF-8 and -8M grades of stainless steels aged at 400 or 450°C. The existing correlations do not accurately represent the embrittlement behavior over the temperature range 300 to 450°C. 18 refs., 13 figs.

7440 **(CONF-8510173—27) Pressurized-thermal-shock experiments: PTSE-1 results and PTSE-2 plans.** Bryan, R.H.; Nanstad, R.K.; Wanner, R.; Merkle, J.G.; Robinson, G.C.; Whitman; G.D. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01 - GPO. File Number TI86003079.

From 13. water reactor safety research information meeting; Gaithersburg, MD, USA (22 Oct 1985).

The first pressurized-thermal-shock experiment (PTSE-1) was performed with a vessel with a 1-m-long flaw in a plug of specially tempered steel having the composition of SA-508 forging steel. The second experiment (PTSE-2) will have a similar arrangement, but the material in which the flaw will be implanted is being prepared to have low tearing resistance. Special tempering of a 2 1/4 Cr - 1 Mo steel plate has been shown to induce a low Charpy impact energy in the upper-shelf temperature range. The purpose of PTSE-2 is to investigate the fracture behavior of low-upper-shelf material in a vessel under the combined loading of concurrent pressure and thermal shock. The primary objective of the experimental plan is to induce a rapidly propagating cleavage fracture under conditions that are likely to induce a ductile tearing instability at the time of arrest of the cleavage fracture. The secondary objective of the test is to extend the range of the investigation of warm prestressing. 11 figs.

7441 **(CONF-8511126—1) Flux-line pinning by the grain boundary in niobium bicrystals.** Kerchner, H.R.; Christen, D.K.; Lee, E.M.; DasGupta, A.; Cai, B.C.; Chou, Y.T. (Oak Ridge National Lab., TN (USA); Lehigh Univ., Bethlehem, PA (USA)). Nov 1985. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003090.

From International symposium on flux pinning and electromagnetic properties in superconductors; Fukuoka, Japan (11 Nov 1985).

Flux-line pinning by the grain boundary in niobium bicrystals was investigated by making four-terminal measurements of the critical current and neutron diffraction measurements of the flux-line bending. The elementary pinning interaction is estimated from the critical current data by using an approximate theory of the current distribution on the grain boundary. The data reported here are mainly for a sample in which the applied magnetic field is parallel to the [111] and the [001] crystal directions in the two grains when it is in the plane of the boundary and perpendicular to the current direction. Evidence is seen of grain boundary faceting and of a flux-flow rectification effect that peaks as a function of temperature below 3°K. The scale of the grain-boundary pinning is consistent with the quasiparticle-scattering theory.

7442 **(DOE/ER/01367—157) Role of hydrogen, sulfur and other impurities in intergranular fracture in iron.** Shin, K.S.; Meshii, M. (Arizona State Univ., Tempe (USA). Dept. of Mechanical and Aerospace Engineering; Northwestern Univ., Evanston, IL (USA). Dept. of Materials Science and Engineering). 1985. Contract AC02-76ER01367. 4p. (CONF-850823—5; COO—1367-157). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001884.

From 7. international conference on the strength of metals and alloys; Montreal, Canada (12 Aug 1985).

The intergranular fracture stress was investigated as a function of grain boundary concentrations of sulfur and/or H in polycrystalline MRC-VP iron specimens. The fracture energy was determined as a function of grain boundary sulfur concentration by analyzing the empirical relations with a modified Griffith equation. Two different effects of H, permanent and reversible, were identified. The permanent effect of H was caused by the formation of intergranular microcracks due to the precipitation of supersaturated H and recovered only partially after annealing at high temperatures. The size of microcracks was found to be proportional to the square of H concentration at grain boundaries. The predicted sizes of the microcracks agreed well with those determined metallographically. The present study clearly indicates that there is no synergistic effect between H and sulfur on intergranular fracture of iron regardless of whether the H effect is reversible or permanent. It was found that the primary effect of C is to displace sulfur from grain boundaries and thus to improve the grain boundary strength by reducing the embrittling effect of sulfur. The second effect of C is to increase the frictional stress to dislocation motion and thus to increase the apparent stress for intergranular fracture.

7443 **(DOE/ER/01367—158) Effects of quenched-in hydrogen on deformation of iron single crystals.** Hashimoto, K.; Meshii, M. (Northwestern Univ., Evanston, IL (USA)). 1985. Contract AC02-76ER01367. 4p. (CONF-850823—4; COO—1367-158). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001883.

From 7. international conference on the strength of metals and alloys; Montreal, Canada (12 Aug 1985).

Effects of hydrogen on mechanical properties were investigated in iron single crystals quenched from temperatures between 833 and 1133 K in a hydrogen atmosphere. The specimens were tensile-tested in a temperature range from 77 to 200 K. The specimens quenched from 1133 K deformed almost exclusively by twinning and fractured at 77 K, the reference specimens cooled slowly from 1133 K deformed plastically without twinning and failed in a ductile manner. The twinning stress was lower that the yield stress of the reference specimens. Aging at room temperature completely eliminated the effect of hydrogen-quenching, indicating that hydrogen dissolved in iron is responsible for twinning. The specimens oriented to the [110] tensile direction deformed substantially even if they were quenched from 1133 K in a hydrogen atmosphere. The flow stress of the hydrogen-quenched specimens was lower than that of the reference specimens in the temperature range from 77 to 200 K. This softening effect was smallest at 200 K.

7444 **(DOE/ER/10855—5) Metal-support interactions: their effects upon absorption, electronic, and activity/selectivity properties of cobalt in CO hydrogenation. Annual progress report, April 1, 1985 - March 31, 1986.** Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA). Catalysis Lab.). 1 Apr 1986. Contract AC02-81ER10855. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003359.

This work involves a comprehensive, quantitative investigation of the effects of metal-support interactions on the adsorption, catalytic, and electronic properties of cobalt (and to a lesser extent iron), the objectives of which are to determine: effects of cobalt-support interactions and cobalt dispersion on the binding states, binding energies and species distribution of CO adsorbed on cobalt, the relation of dispersion and chemical state of cobalt to its activity/selectivity properties in CO hydrogenation, and the extent of electronic interaction of cobalt and iron with various supports.

7445 **(EGG-M—11985) Microstructural characterization of rapidly solidified Type 304 stainless steel.** Wright, R.N.; Flinn, J.E.; Korth, G.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1985. Contract AC07-76ID01570. 12p. (CONF-851217—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003245.

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

The microstructures of rapidly solidified Type 304 stainless steel powders produced by vacuum gas (VGA) and centrifugal (CA) atomization have been examined. The solidification morphology and phase distribution have been characterized using optical and scanning electron microscopy, and the relative amounts of ferrite and austenite have been quantified using x-ray diffraction. It has been found that most CA powder particles contain both fcc and bcc phases, with the bcc phase predominating at small particle sizes and the fcc phase at large particle sizes. The VGA powder generally contains less ferrite, with very little dependence on the particle size. In both powders the ferrite was found to be metastable and to transform to austenite on annealing at 900°C.

7446 **(EGG-M—26385) Limits of applicability of models predicting initiation of crack growth for surface cracks.** Reuter, W.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 11p. (CONF-8510176—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003218.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

In predicting the integrity of a structural component containing surface cracks, the general approach for plane strain, linear-elas-

tic conditions is to use the plane strain fracture toughness and appropriate analytical solutions. The general adequacy of this approach has been verified although the accuracy has not been quantified for many conditions. For conditions of increased ductility (elastic-plastic, E/P, and plastic) it is possible to measure the J-integral associated with initiation of crack growth and the tearing modulus. There are no generally accepted analytical solutions for predicting the behavior of a generic surface crack. This paper summarizes results obtained by comparing predicted stresses with experimentally determined stresses for crack initiation and crack penetration of the wall thickness. Test data were generated for A710 and Ti-15-3 for elastic conditions and A710 for E/P and plastic conditions.

7447 **(HEDL—7553) Sensitization of Parker fittings.** Wilber, W.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1985. Contract AC06-76FF02170. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85018506.

At your request, ferrules from 316 SS Parker-Hannifen compression fittings at the FFTF have been examined and evaluated to determine the metallurgical condition as related to carbide precipitation in grain boundaries (known as sensitization) and the implications this may have with regard to corrosion resistance. To accomplish this, two ferrules from new stock, two ferrules from old stock and two ferrules that had seen service were examined metallurgically. The samples were prepared for optical metallography. They were viewed in both the etched and unetched condition and analyzed on the scanning electron microscope (SEM) for elemental content. It was confirmed that the ferrules from new stock had a 5 mil thick nitrided layer on the ferrule ID at the lead end and that the 316 SS ferrule material was in the sensitized condition, indicating low resistance to aqueous corrosion. The material from old stock had no nitride layer but was in the sensitized condition indicating low resistance to aqueous corrosion. The ferrules that had seen service had not been nitrided and were not sensitized indicating high resistance to aqueous corrosion.

7448 **(HEDL-SA—3353) New developments in irradiation-induced microstructural evolution of austenitic alloys and their consequences on mechanical properties.** Garner, F.A.; Brager, H.R.; Hamilton, M.L.; Dodd, R.A.; Porter, D.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 1985. Contract AC06-76FF02170. 29p. (CONF-8506165—4). NTIS, PC A03/MF A01; GPO Dep. File Number DE86004016.

From Workshop on the relation between mechanical properties and micro-structure under fusion irradiation conditions; Ebeltoft, Denmark (27 Jun 1985).

A survey is presented of recent development in the study of radiation-induced changes in the microstructure of austenitic structural alloys that occur in fission reactors. The associated macroscopic consequences of these changes on both mechanical properties and dimensional stability are also reviewed. It is anticipated that some changes will occur in these phenomena as a result of the differences inherent in fission and fusion neutron spectra, but relevant data obtained to date do not indicate that the effects of helium and several other transmutation-related changes will be large. 78 refs., 12 figs.

7449 **(LBL—19214) Microstructure of Fe-Didymium-B magnets.** Ramesh, R.; Krishnan, K.M.; Goo, E.; Thomas, G.; Okada, M.; Homma, M. (Lawrence Berkeley Lab., CA (USA)). Sep 1985. Contract AC03-76SF00098. 14p. (CONF-850890—23). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002890.

From International conference on magnetism; San Francisco, CA, USA (26 Aug 1985).

A TEM study has been made to characterize the microstructure and composition of the phases in the Fe-Didymium-B magnets. (Didymium is a mixture of Nd, Pr, and Ce.) The main phase is the tetragonal $RE_2Fe_{14}B$ phase. In all the samples observed, a triple junction fcc phase which frequently extended into two-grain junctions, was observed with a lattice parameter of 5.24 A and enriched in Ce, Pr and Nd. The magnets with poorer properties had a considerable amount of the rare-earth oxide.

7450 **(LBL—19233) Magneto-mechanical effects in two steels with metastable austenite.** Fultz, B.; Fior, G.O.; Chang, G.M.; Kopa, R.; Morris, J.W. Jr. (Lawrence Berkeley Lab., CA (USA)). Mar 1985. Contract AC03-76SF00098. 15p. (CONF-850814—29). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002865.

From Cryogenic engineering conference and international cryogenic materials conference; Boston, MA, USA (12 Aug 1985).

Magneto-mechanical effects, or effects of magnetic fields on mechanical propeties of materials, are reported for two steels containing austenite that undergoes an fcc→bcc martensitic transformation during plastic deformation. Stress-strain curves from tensile tests of AISI 304 stainless steels and 9Ni steels were measured in magnetic fields as large as 18 T at temperatures of 4°K, 77°K and room temperature. Even in 18 T magnetic fields at cryogenic temperatures the magneto-mechanical effects were small, but they were reproducible and scaled with the strength of the magnetic field and the amount of transformation. Magneto-mechanical effects in steels with metastable austenite provide a unique means of determining how martensitic transformations affect mechanical behavior. The fcc→bcc transformation makes an important contribution to the work hardening of both AISI 304 and 9Ni steel, so the more rapid transformation during magnetic exposure results in a higher strength and a reduced elongation of tensile specimens. In AISI 304 stainless steel a reduced flow stress in the magnetic field was found at small plastic strains.

7451 **(LBL—19828) Comparison of fatigue crack propagation in Modes I and III.** Ritchie, R.O. (Lawrence Berkeley Lab., CA (USA)). Jun 1985. Contract AC03-76SF00098. 47p. (CONF-850679—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86002877.

From 18. American Society for Testing and Materials symposium; Boulder, CO, USA (1 Jun 1985).

The propagation behavior of fatigue cracks in Mode III (anti-plane shear), measured under cyclic torsion, is described and compared with more commonly encountered behavior under Mode I (tensile opening) loads. It is shown that a unique, global characterization of Mode III growth rates, akin to the Paris "law" in Mode I, is only possible if characterizating parameters appropriate to large-scale yielding are employed and allowance is made for crack tip shielding from sliding crack surface interference (i.e., friction and abrasion) between mating fracture surfaces. Based on the crack tip stress and deformation fields for Mode III stationary cracks, the cyclic crack tip displacement, (ΔCTD/sub III/, and plastic strain intensity range ΔΓ/sub III/, have been proposed and are found to provide an adequate description of behavior in a range of steels, provided crack surface interference is minimized. The magnitude of this interference, which is somewhat analogous to crack closure in Mode I, is further examined in the light of the complex fractography of torsional fatigue failures and the question of a "fatigue threshold" for Mode III crack growth. Finally, micromechanical models for cyclic crack extension in anti-plane shear are briefly described, and the contrasting behavior between Mode III and Mode I cracks subjected to simple variable amplitude spectra is examined in terms of the differing role of crack tip blunting and closure in influencing shear, as opposed to tensile opening, modes of crack growth.

7452 **(LBL—19947) Accurate structure factor determination of binary cubic solid solutions.** Fox, A.G.; Fisher, R.M. (Lawrence Berkeley Lab., CA (USA); Wolverhampton Polytechnic (UK). School of Engineering). Jul 1985. Contract AC03-76SF00098. 6p. (CONF-8509168—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002891.

From Electron microscopy and analysis group conference; Newcastle-Upon-Tyne, England (2 Sep 1985).

The Critical Voltage technique (V/sub C/) in HEED can measure low angle x-ray structure factors of crystalline materials to within 0.1% provided accurate higher angle structure factors and Debye-Waller factors are available. The extension of this technique to a range of alloys in the systems CuAu, CuAl and FeCr is presented.

7453 **(LBL—20218) Specific heat of $CeAl_3$ below 20K in fields to 8T. Effect of $CeAl_2$ and/or Ce_3Al_{11} phases.** Brodale, G.E.; Fisher, R.A.; Lisse, C.M.; Phillips, N.E.; Edelstein, A.S. (Lawrence Berkeley Lab., CA (USA); Naval Research Lab., Washington, DC (USA)). Aug 1985. Contract AC03-76SF00098. 14p. (CONF-850890—21). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001984.

From International conference on magnetism; San Francisco, CA, USA (26 Aug 1985).

Four polycrystalline samples of $CeAl_3$ containing $CeAl_3$ and/or Ce_3Al_{11} phases (2.6 to 13 wt %) have been studied at 0.35 less than or equal to T less than or equal to 20K and 0 less than or equal to H less than or equal to 8T. The specific heat for all samples agreed after correction for the impurities. The results below 1K are compared with the RLM using a T dependent Δ.

7454 **(LBL—20326) Effect of surface applied reactive element oxides on the oxidation of Cr-containing binary alloys.** Hou, P.Y.; Stringer, J. (Lawrence Berkeley Lab., CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1985. Contract AC03-76SF00098. 29p. (CONF-851048—9). NTIS, PC A03/MF A01; GPO Dep. File Number DE86002878.

From 168. meeting of the Electrochemical Society; Las Vegas, NV, USA (13 Oct 1985).

The influence of surface applied Ca, Ce, Hf, La, Y, and Zr nitrate-converted oxides on the oxidation behavior of Co-15 wt % Cr, Co-25 wt % Cr and Ni-25 wt % Cr alloys at 1000°C in 1 atm O_2 has been studied. The surface oxides appeared to be most beneficial on the established Cr_2O_3 forming alloy, showed no effects on the non-Cr_2O_3 forming alloy, showed no effects on the non-Cr_2O_3 forming alloy and acted as a semi-barrier on the borderline Cr_2O_3 former. Results are compared and discussed with the effects found when the reactive element oxides are present as dispersions within the alloys. 10 figs.

7455 **(MLM—3320(OP)) Pulsed laser weldability of aluminum alloys.** Weeter, L.A. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1985. Contract AC04-76DP00053. 9p. (CONF-8511103—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003731.

From ICALEO international congress on the applications of lasers and electro-optics; San Francisco, CA, USA (11 Nov 1985).

This study was undertaken to determine the weldability of six aluminum alloys (1100, 3003, 4043, 4047, 5356, and 6061) in similar alloy, dissimilar alloy, and similar alloy with a 4047 filler metal addition combinations. The Pulsed Laser Weldability Test was used to evaluate the weldability of the various alloy combinations. The Pulsed Laser Weldability Test rated the weldability of the six aluminum alloys from least crack sensitive to most crack sensitive as: 1100, 4047, 4043, 3003, 5356, 6061. The results of joining 1100, 3003, 5356, or 6061 to either 4043 or 4047 in an approximately 50% mixture revealed that all of these combinations were very crack sensitive. The addition of smaller amounts of 4047 to either 5356 or 6061 revealed the same phenomenon. 0.08, 0.13, and 0.25 millimeter thick sheets of 4047 were placed between two pieces of either 5356 or 6061 and the weldability test was performed. All of the filler metal additions made crack sensitive joints. A 0.38 mm thick sheet of 4047 was also tested between 5356 or 6061. However, this sheet was too thick for the Pulsed Laser Weldability Test to accurately evaluate.

7456 **(N—84-23746) Damage due to high temperature corrosion.** (Allianz-Zentrum fuer Technik G.m.b.H. (AZT), Ismaning (Germany, F.R.)). 1983. 30p. (In German). Issuing Activity.

Different types of high temperature corrosion (HTC) are described. Reaction thermodynamics, reaction kinetics, and characteristics are presented for HTC in hot gases (oxidation, carbonization, attack by hydrogen), HTC under deposits (HTC on overheating pipes of coal fired boilers, HTC on gas turbine blades), and HTC in metal melting. (ESA)

7457 **(N—84-23751) Solubility of hydrogen in metals and its effect of pore-formation and embrittlement.** Shahani, H.R. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Casting of Metals). 1984. 122p. NTIS, PC A06/MF A01.

The effect of alloying elements on hydrogen solubility were determined by evaluating solubility equations and interaction coefficients. The solubility of dry hydrogen at one atmosphere was investigated in liquid aluminum, Al-Ti, Al-Si, Al-Fe, liquid gold, Au-Cu, and Au-Pd. The design of rapid heating and high pressure casting furnaces used in meta foam experiments is discussed as well as the mechanism of precipitation of pores in melts, and the effect of hydrogen on the shrinkage porosity of Al-Cu and Al-Si alloys. Hydrogen embrittlement in iron base alloys is also examined.

7458 **(SAND—85-1427) Residual stresses in uranium and uranium alloys.** Eckelmeyer, K.H. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86004231.

Residual stresses are generated in uranium alloys primarily by metal working operations and heat treatments. These stresses can be large enough to seriously degrade material manufacturability and integrity. They have been observed to cause centerline bursting in bars, stress corrosion cracking in components of various geometries subjected to a variety of environments, and distortion during machining. The magnitudes and consequences of these stresses can be minimized by mechanical or thermal stress relieving. Residual stresses in uranium alloy components have been measured mostly by destructive relaxation methods, but recently a non-destructive neutron diffraction method has been developed. 38 refs., 12 figs.

7459 **(SAND—85-1961C) Microstructures of surface-melted alloys.** Follstaedt, D.M.; Picraux, S.T. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 86p. (CONF-8510160—8). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86002916.

From ASM metals congress - international conference on surface modifications; Toronto, Ontario, Canada (13 Oct 1985).

The microstructures formed by rapid melting and solidification of surface alloys on metal substrates are described for fast laser and electron beam heating. Primary emphasis is placed on developing a general perspective on the materials science of rapid solidification. Surface melting produces controllable and calculable thermal histories, which allow quantitative evaluation of kinetic and thermodynamic alloy parameters affecting the microstructures produced by rapid solidification. The heating and cooling rates obtainable with surface melting (up to 10^{10} K/s) allow faster quenching regimes to be examined. The wide range of microstructures which can be accessed by surface melting is illustrated in turn for pure metals, ion-implanted surface alloys, deposited layer alloys and engineering alloys.

7460 **(SAND—85-2384C) Spot spectroscopy of highly ionized europium.** Bailey, J.; Kilkenny, J.D.; Weber, D.; Scofield, J.H.; Lee, Y. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 32p. (CONF-851136—2). NTIS, PC A03. File Number DE86002922.

From Meeting of the Plasma Physics Division of the American Physical Society; San Diego, CA, USA (4 Nov 1985).

Microdot spectroscopy of a laser produced plasma was used to study the x-ray emission from highly-ionized europium in the wavelength region between 6.5A and 9.6 A. New identifications of spectral lines from Eu ions isoelectronic with Ni, Co, and Fe were made using ab initio calculations of the wavelengths and gf values. The emission was measured with spatial and temporal resolution and as a function of the irradiance. The relative intensities of the 3d-4f transitions from different ionization stages were compared with the ionization distribution predicted by a collisional-radiative model.

7461 (SAND—85-2619C) Early stages of reaction between amorphous Ni-Nb and crystalline Au films. Dobisz, E.A.; Craighead, H.G.; Perepezko, J.H.; Wiley, J.D.; Doyle, B.L.; Peercy, P.S. (Bell Communications Research, Inc., Holmdel, NJ (USA); Wisconsin Univ., Madison (USA); Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 11p. (CONF-851217—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003723.

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

Thin film interactions between a-(Ni-Nb) and polycrystalline Au overlayers have been studied with high depth resolution (≦ 17A) Rutherford backscattering (RBS) and TEM to obtain information on the early stages of reactions at the interface. The RBS spectra from Au indicated that the interdiffused samples consisted of two layers: an Au-Nb binary layer on the surface and a ternary Au-Ni-Nb compound layer beneath the binary layer. This growth kinetics of the ternary compound later differed for unrelaxed samples and samples which had been relaxed prior to Au deposition. Cross-section TEM showed that relaxed and unrelaxed samples exhibit different microstructures. We interpret this result to indicate that the reaction stages in the relaxed samples are less advanced than those in the unrelaxed samples.

7462 (UCID—20509) FY 1985 status report on feasibility assessment of copper-base waste package container materials in a tuff repository. McCright, R.D. (Lawrence Livermore National Lab., CA (USA)). 30 Sep 1985. Contract W-7405-ENG-48. 129p. NTIS, PC A07/MF A01; GPO Dep. File Number DE86003960.

This report discusses progress made during the first year of a two-year study on the feasibility of using copper or a copper-base alloy as a container material for a waste package in a potential repository in tuff rock at the Yucca Mountain site in Nevada. The expected corrosion and oxidation performances of oxygen-free copper, aluminum bronze, and 70% copper-30% nickel are presented; a test plan for determining whether copper or one of the alloys can meet the containment requirements is outlined. Some preliminary corrosion test data are presented and discussed. Fabrication and joining techniques for forming waste package containers are descibed. Preliminary test data and analyses indicate that copper and copper-base alloys have several attractive features as waste package container materials, but additional work is needed before definitive conclusions can be made on the feasibility of using copper or a copper-base alloy for containers. Plans for work to be undertaken in the second year are indicated.

7463 (UCID—20597) Electrochemical evaluation of the effect of heat treatment and stress on the corrosion characteristics of 7050 aluminum in 3.5% NaCl solution. Glass, R.S.; Estill, J.C. (Lawrence Livermore National Lab., CA (USA)). Nov 1985. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86004181.

Potentiodynamic polarization curves have been used to evaluate (in a survey mode) the effect of heat treatment and stress on the corrosion behavior of 7050-XX aluminum in deaerated 3.5% NaCl solutions. Specimens, which were machined from extruded ring material, were examined in the as-received condition and following heat treatment at 580°F for 0.5 min. The stress levels used in this study ranged from 40 to 90% of the 0.2% offset yield strength. Results indicate that within this stress range, using the given experimental method, medium, and timescales, that there is no significant trend for the effect of stress on the electrochemical-corrosion behavior for the materials examined. The heat-treated specimens have lower uniform corrosion rates than the as-received forms, but are more susceptible to pitting. However, pitting is not spontaneous for either material in this environment. In addition to investigating the variables of stress and heat treatment, we have also compared the behavior of specimens machined from three different orientations within extruded ring material. Generally, the longitudinal and circumferentially oriented specimens were more similar electrochemically than specimens obtained from the radial orientation. The radial specimens generally showed lower uniform corrosion rates and appeared to be less susceptible to pitting.

7464 (UCRL—90427) Thermionic emission and work function of U and UO_2. McLean, W.; Chen, H.L. (Lawrence Livermore National Lab., CA (USA)). Feb 1985. Contract W-7405-ENG-48. 22p. (CONF-8406187—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002626.

From 6. symposium on applied surface analysis; Dayton, OH, USA (6 Jun 1984).

Thermionic emission measurements have been used to determine the work function (phi) of pure and oxidized uranium samples between 1100 and 1300°K; Auger electron spectroscopy (AES) was used to verify the cleanliness and compositions of the samples. It was found that impurities present in ppM amounts in the bulk U segregated to the surface upon heating and had an appreciable effect on the zero-field emission currents as well as the slopes of the Schottkey curves obtained at various temperatures. A combination of ion-sputtering and ultra-high vacuum (UHV) annealing at high temperatures was successful in reducing the total impurity level on the hot surfaces to ~5%. At this low concentration of impurities, well-behaved Richardson line plots were obtained with $A = 135$ A $cm^{-2} K^{-2}$ and phi = 3.54 eV for pure U, and $A = 128$ A $cm^{-2} K^{-2}$ and phi = 3.19 eV for UO_2. The Schottkey coefficients for clean U approached their ideal values at fields > 400 V/cm.

7465 (UCRL—93632) Crystallization and nucleation phenomena in CW surface melted alloys. Kaufmann, E.N.; Wallace, R.J. (Lawrence Livermore National Lab., CA (USA)). Nov 1985. Contract W-7405-ENG-48. 39p. (CONF-8509150—4). NTIS, PC A03/MF A01; GPO Dep. File Number DE86003886.

From NATO advanced study institute; San Miniato, Italy (2 Sep 1985).

This paper shows what types of nucleation and growth phenomena one might encounter in rapid surface melting experiments. In growth rate considerations, the ratio of the diffusion coefficient to some characteristic diffusion length, be it an atomic distance or an eutectic lamellar spacing, is required to explain observations. Similarly in analysis of nucleation phenomena, the site densities and potency of catalytic sites are quantities which need to be parameterized. Thus, the suggested approach to the wide variety of problems yet to be resolved in this field is to utilize the form of surface processing illustrated here in a highly controlled way with adequate computer simulations such that the unknown parameters might be determined for a wide variety of cases.

7466 (Y/DV—436) Examination of the copper crucible cracks in the arc-melt skull caster. Richey, M.W.; Houck, C.W. (Oak Ridge Y-12 Plant, TN (USA)). 12 Jun 1985. Contract AC05-84OS21400. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003753.

During production of U-6% Nb at the Oak Ridge Y-12 Plant, cracking has been experienced along the top and around the periphery of one of the vacuum arc-melting furnaces. The mode of crack initiation and propagation observed in the copper crucible is characteristic of thermal fatigue. The thermal fatigue cracks observed in the copper crucible result from thermally-induced strains acting on a crack susceptible microstructure (coarse-grained heat-affected zone). Reduction or elimination of the crucible cracking in the skull melter may be possible by altering the crucible design to decrease thermal strains and modifying welding procedures to lessen the extent of the crack-susceptible microstructure.

7467 New equation of state for aluminum. Holian, K.S. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* 59: No. 1, 149-157(1 Jan 1986).

A new equation of state (EOS) has been produced for aluminum, which accurately reproduces experimental data for both the liquid and solid states. It also has a melting transition that reproduces measurements of the temperature vs pressure along the melt line. The liquid part of the EOS was calculated with the soft-sphere model for liquid metals, and the solid EOS is based upon a Birch-equation cold curve and Grueneisen thermal contributions. The range of the table extends from room temperature to 1.6 eV and from densities of 10^{-3}—10^{3} g/cm³.

7468 Compton profiles for polycrystalline Cu/sub x/Ni/sub 1-x/ alloys: Theory and experiment. Benedek, R.; Prasad, R.; Manninen, S.; Sharma, B.K.; Bansil, A.; Mijnarends, P.E. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **32**: No. 12, 7650-7658(15 Dec 1985). Contract W-31-109-ENG-38.

We present experimental and theoretical Compton profiles, J(q), for a series of Cu/sub x/Ni/sub 1-x/ alloys. This is the first comprehensive study of Compton profiles in an alloy system. The experiments were carried out using 60-keV γ rays on five polycrystalline alloy samples with Cu concentrations x = 0.40,0.50,0.55,0.60,0.65 and on pure Cu and pure Ni. Our computations of J(q) are based on the Korringa-Kohn-Rostoker coherent-potential approximation scheme for treating the average electronic spectrum of the alloy. The theory reproduces the main features of the observed Compton profiles. The experimental Compton profiles show a nearly linear dependence on concentration while the theoretically predicted Compton profiles are more nonlinear at low q. We discuss possible explanations for this discrepancy. We also discuss the relation between J(q) and the alloy Fermi surface.

7469 Lattice dynamics of bcc Sr. Mizuki, J.; Stassis, C. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **32**: No. 12, 8372-8374(15 Dec 1985). Contract W-7405-ENG-82.

A large single crystal of bcc Sr was grown in situ and was used to study the lattice dynamics of this divalent metal by coherent inelastic neutron scattering. The phonon dispersion curves were measured, at 930 K, along the [ξ00], [ξξ0], and [ξξξ] symmetry directions. Along the [ξ00] symmetry direction, the frequencies of the longitudinal curve are higher than those of the transverse branch, whereas in bcc Ba, the relative ordering of these branches is reversed. This result is consistent with the assumption that the anomalous behavior of the [ξ00] dispersion curves in bcc Ba is due to the hybridization of the free-electron-like states with the d bands. The data were used to evaluate the elastic constants, the phonon density of states, and the lattice specific heat of bcc Sr.

7470 Grazing incidence reflection coefficients of rhodium, osmium, platinum, and gold from 50 to 300 A. Hettrick, M.C.; Flint, S.A.; Edelstein, J. (University of California, Lawrence Berkeley Laboratory, Center for X-Ray Optics, Berkeley, California 94720). *Applied Optics;* **24**: No. 22, 3682-3684(15 Nov 1985). Contract AC03-76SF00098.

Reflection coefficients of rhodium, osmium, platinum, and gold coatings have been measured for various incidence angles in the wavelength range 46.5 through 283 angstroms. (AIP)

7471 Renormalization-group theory of spinodal decomposition. Mazenko, G.F.; Valls, O.T.; Zhang, F.C. (The James Franck Institute and The Department of Physics, The University of Chicago, Chicago, Illinois 60637). *Physical Review [Section] B: Condensed Matter;* **32**: No. 9, 5807-5817(1 Nov 1985).

Renormalization-group (RG) methods developed previously for the study of the growth of order in unstable systems are extended to treat the spinodal decomposition of the two-dimensional spin-exchange kinetic Ising model. The conservation of the order parameter and fixed-length sum rule are properly preserved in the theory. Various correlation functions in both coordinate and momentum space are calculated as functions of time. The scaling function for the structure factor is extracted. We compare our results with direct Monte Carlo (MC) simulations and find them in good agreement. The time rescaling parameter entering the RG analysis is temperature dependent, as was determined in previous work through a RG analysis of MC simulations. The results exhibit a long-time logarithmic growth law for the typical domain size, both analytically and numerically. In the time region where MC simulations have previously been performed, the logarithmic growth law can be fitted to a power law with an effective exponent. This exponent is found to be in excellent agreement with the result of MC simulations. The logarithmic growth law agrees with a physical model of interfacial motion which involves an interplay between the local curvature and an activated jump across the interface.

7472 Neutron-diffraction studies of UBe_{13} and $ThBe_{13}$. Goldman, A.I.; Shapiro, S.M.; Cox, D.E.; Smith, J.L.; Fisk, Z. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **32**: No. 9, 6042-6044(1 Nov 1985). Contract AC02-76CH00016.

Neutron-diffraction measurements have been made on polycrystalline samples of UBe_{13} and $ThBe_{13}$ at several temperatures between 10 and 250 K. Refinement of the powder patterns using the Rietveld method of profile analysis yields structural parameters in substantial agreement with previous work [space group C/sub g/^{6} (Fm3c); 8 U in 8(a); 8 Be(I) in 8(b); 96 Be(II) in 96(i)]. Values for the (y,z) coordinates of the 96 Be(II) are (0.1763, 0.1150) and (0.1745, 0.1129) for UBe_{13} and $ThBe_{13}$, respectively. They correspond very closely to those values required for regular snub-cube coordination of the Be(II) around the uranium atoms.

7473 An experimental and theoretical study of the infrared reflectance of thin oxide films on metals. Ottesen, D.K. (Sandia National Laboratories, Livermore, California). *Journal of the Electrochemical Society;* **132**: No. 9, 2250-2257(Sep 1985).

External reflectance infrared spectroscopy has been used to study the formation of oxide films on chromium and iron alloys. Experimental data have been acquired with an FTIR spectrometer using a polarized beam at high angles of incidence to the surface normal. Theoretical calculations have been made for these systems and are compared with the experimental results. Particular attention is given to the quantitative calculation of film thickness. Complications which arise from distortions in band shape, frequency shifts, the appearance of additional reflectance minima, and beam divergence and state of polarization are discussed in detail.

7474 GTA weld cracking-alloy 625 to 304L. Patterson, R.A.; Milewski, J.O. (Los Alamos National Laboratory, Los Alamos, NM). *Welding Journal (Miami);* **64**: No. 8, 227-S-232-S(Aug 1985).

Autogenous gas tungsten arc welds joining alloy 625 and 304L stainless steel were found to be susceptible to weld solidification cracking. Utilization of pulsed current GTA welding produced a higher sensitivity to solidification cracks than continuous current welding. Spot Varestraint tests show that the sensitivity of this dissimilar metal combination to cracking exists over the entire range of dilutions while the greatest sensitivity is in 304L stainless steel rich compositions. Auger electron spectroscopy indicates that segregation of sulfur and phosphorous to the interdendritic phase promotes the hot cracking.

7475 Passivation of titanium by molybdate Ion. Glass, R.S. (Sandia National Laboratories, Albuquerque, NM). *Corrosion (Houston);* **41**: No. 2, 89-93(Feb 1985).

The passivating effect of molybdate ion on the corrosion of titanium in deaerated, boiling 1N H_2SO_4 has been explored. In this medium, in the absence of molybdate ion, titanium rapidly corrodes. An immediate passivation process for Ti is observed when Mo^{+6} at a concentration as low as 3 mM is added to an H_2SO_4 solution in which Ti is actively corroding. The open cir cuit potential attained for Ti in molybdate solution is shown to be controlled by redox processes. Through a combination of surface analytical and electrochemical data, it is shown that upon immersion of Ti in acidic molybdate solution, the native TiO_2 oxide is replaced by a salt film containing Mo. This film is adherent when a passivated electrode is transferred to a molybdate-free solution and it provides a corrosion resistant barrier.

7476 Sulfur segregation on nickel. Miyahara, T.; Birnbaum, H.K.; Reed, D.A.; Stolt, K. (Materials Research Laboratory and Department of Metallurgy and Mining Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois). *Scripta Metallurgica;* **19**: No. 1, 117-121(Jan 1985).

Despite the significance of S segregation to grain boundaries and surfaces in Ni relatively few determinations of important parameters such as the solubility (1), diffusivity (1,2) and heat of adsorption (3,4) have been carried out. The adsorption enthalpy of S

on powdered Ni was determined to be -464 kJ mole^{-1} (-4.8 eV) relative to S(g) at 800 K (3) and was estimated to be -510 kJ mole^{-1} (-5.3 eV) using a H_2+ ion induced desorption technique (4). Both of these values are larger than the estimated cohesive energy of Ni metal, which is 433 kJ mole^{-1} (4.5 eV) (5). In the present experiments the thermodynamics of segregation and adsorption of S on the surface of Ni has been studied to determine the heats of segregation and adsorption. The concentration of sulfur on the surface of Ni was determined as a function of temperature using A.E.S. techniques. Saturation coverage ($\theta \approx 0.5$) was observed below about 1250 K and equilibrium coverage was observed above that temperature. Analysis of the results yielded an enthalpy of segregation of S relative to the solid solution of -135 kJ mole^{-1} (-1.4 eV) and an enthalpy of adsorption of S of -189 kJ mole^{-1} (-1.96 eV) relative to 1/2 S_2(g).

7477 Metastable equilibrium of ferrite in type 308 stainless steel. Vitek, J.M.; David, S.A. (Metals and Ceramics Division, Oak Ridge National Laboratory Oak Ridge, Tennessee). *Scripta Metallurgica;* **19**: No. 1, 23-26(Jan 1985).

The stability of type 308 stainless steel weld filler metal following elevated temperature aging has been the subject of an extensive research effort at Oak Ridge National Laboratory (ORNL). These studies on both homogenized and welded materials have shown that the ferrite phase transforms to austenite and sigma phase and no residual ferrite is expected in equilibrium in the temperature range of 550 to 850°C. However, the transformation to sigma is very sluggish, with some residual ferrite often present after aging times of 1000 h or more. As an offshoot of the aging studies, the composition of ferrite has been evaluated as a function of aging time and temperature and these results and their interpretation are the focus of this paper.

7478 A collision model for fume formation in metal oxidation. Raynaud, G.M.; Rapp, R.A. (Department of Metallurgical Engineering, The Ohio State University, Columbus, OH). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **15A**: No. 3, 587-596(Mar 1984).

During the oxidation of copper at high temperatures, two simultaneous mechanisms are observed in the hot stage environmental scanning electron microscope: the nucleation and growth of solid cuprous oxide crystals and the formation of a solid fume composed of very small copper and copper oxide particles. A collision model for fume formation in metal oxidation is presented. By calculating th collision frequency between evaporated copper atoms and oxygen molecules in the gas phase, the amount of fume formed can be estimated. Although the effect of Van der Waals forces between particles has not been quantified, the temperature difference between the two gases was taken into account and yielded a multiplying factor of 4 in the collision frequency for copper oxidation at 950°C. Unoxidized copper particles were formed from unsuccessful elastic collisions between Cu(v) and O_2. These copper particles are composed of interpenetrating icosohedra and possess a high crystalline perfection.

7479 In situ observation of copper oxidation at high temperatures. Raynaud, G.M.; Clark, W.A.T.; Rapp, R.A. (Department of Metallurgical Engineering, The Ohio State University, Columbus, OH). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **15A**: No. 3, 573-586(Mar 1984).

The high temperature oxidation of OFHC copper was studied inside an environmental hot-stage scanning electron microscope (HSESEM). The evolution of oxidation morphologies was observed at temperatures above 850°C for a maximum oxygen pressure of 3 X 10^{-4} atm. The oxidation products were characterized by high resolution SEM, STEM, EELS, and microdiffraction analysis. Two simultaneous mechanisms were observed: the growth of solid cuprous oxide crystals, and between and on top of these grains, the formation of a solid copper oxide fume. The formation of this oxide fume is very dependent upon the oxygen pressure, the temperature, and the experimental treatment of the specimen. Upon cooling, the cuprous oxide fume undergoes a reversible transformation to cupric oxide at about 519°C, and thus cannot be retained unchanged for post-oxidation analysis. The formation of microfissures in the scale, rapid oxide grain growth, and scale spallation upon thermal cycling were observed in situ. The initial heating of the copper in hydrogen (as cont. asted to the SEM vacuum) resulted in more rapid scale growth and reduced fume formation.

7480 Kinetics of methane bubble growth in a 1020 steel. Panda, B.; Shewmon, P. (Touchstone Research Laboratory, Wheeling, WV). *Metallurgical Transactions,* [*Section*] *A: Physical Metallurgy and Materials Science;* **15A**: No. 3, 487-494(Mar 1984).

A 1020 carbon steel and a sensitive dilatometer have been used to study the changes in the kinetics, and morphology, of methane bubbles with temperature, methane pressure, and bubble size. The transition from roughly spherical bubbles at low methane pressure to lenticular ones at high pressure, as predicted by theory, has been demonstrated along with the predicted change in pressure exponent and activation energy. That is, at high pressures the rate of bubble growth increases as (P /SUB CH4/)^3 and exhibits an activation energy characteristic of surface diffusion, while at quite low pressures th pressure exponent is about 3/2 with an activation energy between that for grain boundary and lattice diffusion. When the lenticular bubbles grow to a diameter roughly equal to that of the grains, their growth kinetics change to be limited by the power law creep of the matrix.

7481 Dissimilar-metal weld failures in boiler tubing. Klueh, R.L. (Oak Ridge National Laboratory, Oak Ridge, TN). *Power Engineering;* **88**: No. 2, 52-56(Feb 1984).

Both ferritic heat-resisting steels and austenitic stainless steels are used for fossil-fired boilers for central power stations. The use of these two different types of materials within the system leads to the need for a dissimilar-metal weld transition joint. Increased cyclic operation of boilers has led to a rash of failures in welds between dissimilar metals; studies have identified the causes, and improved nondestructive testing techniques permit early identification of problem areas.

7482 Early Stages of the Oxidation of Chromium in H_2-H_2O-H_2 Gas Mixtures. LaBranche, M.; Garratt-Reed, A.; Yurek, G.J. (The H.H. Uhlig Corrosion Laboratory, Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts). *Journal of the Electrochemical Society;* **130**: No. 12, 2405-2413(Dec 1983).

The oxidation of (100) and (110) orientations of Cr in H_2-H_2O-H_2S gas mixtures was studied at 900°C with P /SUB O2/ = 10^{-19} atm and P /SUB S2/ = 10^{-14}, 10^{-10}, 10 /SUP -7.5/ and 10 /SUP -6.5/ atm. Specimens were analyzed primarily by SEM, TEM, and STEM. No sulfides were detected after one hour with P /SUB S2/ = 10^{-14} or 10^{-10} atm. Sulfides were detected at the Cr/scale interface with P /SUB S2/ = 10 /SUP -7.5/ atm. Two-phase scales comprising Cr_2O_3 and $Cr_{1-x}S$ formed at P /SUB S2/ = 10 /SUB -6.5/ atm. Preoxidation for two hours with P /SUB O2/ = 10^{-19} atm was successful in preventing sulfur penetration for 20 hr. After 111 hr, however, the initial protective oxide was lost and the scale consisted of a mixture of Cr_2O_3 and Cr /SUB 1-x/ S partially overgrown byCr_2O_3.

3602 CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 6979, 7031, 7273, 7464

7483 (BMFT-FB-T—85-094) Concept for the quality assurance of components of the ceramic gas turbine by nondestructive testing. Goebbels, K.; Reiter, H.; Arnold, W.; Hirsekorn, S. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren). Aug 1985. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86750492.

With 29 refs., 1 tab., 23 figs. .

This work to develop nondestructive testing (NDT) methods for components made from high temperature and high strength ce-

ramics was sponsored during the years 1977-1983 by the BMFT in a ceramic gas turbine program. The central task was to make available NDT methods for the detection of defects with linear dimensions between 10 and 100 μm. The presented final report demonstrates the elaborated concept for the quality assurance. For the surface and volume defects and the structure and stress measurememt three methods are well to the fore: High resolution radiography, filmless with microfocal X-ray tubes amd projection technique. This kind of testing is accomplished by cross section images of the computer tomography with reduced resolution; Ultrasonic testing and ultrasonic microscopy with frequencies between 5 and 200 MHz: Structure characterization (homogeneity) and stress measurement by low frequency (< or approx. 20 MHz) velocity measurements. Detection of surface defects with surface waves. A detection and characterization of volume defects is possible with high frequency ultrasound and vibration analysis (resonance frequency) for large sample series, qualitative and integral characterization of components.

7484 **(CONF-850814—30) High field properties of NbN ribbon conductors.** Capone, D.W. II; Kampwirth, R.T.; Gray, K.E. (Argonne National Lab., IL (USA)). Aug 1985. Contract W-31-109-ENG-38. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85018340.

From Cryogenic engineering conference and international cryogenic materials conference; Boston, MA, USA (12 Aug 1985).

This paper reports the first high field measurements on ribbon conductors composed of NbN and Cu deposited onto Hastelloy ribbons. These ribbons are 5 to 8 cm long, 1/8" wide, and have several microns of NbN, covered with several microns of Cu, deposited onto one side. Such samples have a T/sub c/ ~ 14.5 K, H/sub c2/ (2.0 K) ~ 26 T in the parallel direction and J/sub c/ (20 T, 2.0 K) up to 3 x 10^4 A/cm^2.

7485 **(CONF-8410103—11) Direct brazing of structural ceramics for uncooled diesels.** Moorhead, A.J. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002248.

From Automotive technology development contractors' coordination meeting; Dearborn, MI, USA (29 Oct 1984).

We have developed a broad range of experimental filler metals that will braze structural ceramics such as MgO- and Y_2O_3-stabilized PSZ, several commercial aluminas, an experimental alumina-silicon carbide whisker reinforced composite and sintered α-SiC. At least two of the alloy systems studied show promise for fulfilling the joining needs of the uncooled diesel engine. Our filler metals of composition Ag-30Cu-21Ti, and Cu-20Au-18Ti, at. %, produced ceramic-ceramic brazements that had room temperature flexural strengths greater than 100 MPa and the strengths are very respectable up to 600°C in air. The 1000°C brazing temperature of the Ag-30Cu-21Ti material allowed PSZ-to-nodular cast iron (NCI) brazements to be made without changing the hardness or primarily pearlitic microstructure of the cast iron. Some of the PSZ/NCI brazements had room temperature shear strengths of ~200 MPa, but the values varied greatly, and we are presently trying to determine a reason for this lack of reproducibility.

7486 **(CONF-8509147—12) Band structure of UO_2: an angle resolved and resonant photoemission study.** Arko, A.J.; Koelling, D.D.; Boring, A.M.; Ellis, W.P.; Cox, L.E. (Argonne National Lab., IL (USA); Los Alamos National Lab., NM (USA)). Oct 1985. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004035.

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

A detailed study of angle resolved photoemission of UO_2 <100> in the normal emission configuration is presented. The results are compared to a semirelativistic LAPW band calculation with the actual calculated empty bands used in the data reduction. Excellent agreement is found with calculations both for filled states as well as critical points in the empty states with no adjustment of bands. f-p hybridization is found at the leading edge of the valence band and not at the bottom of the valence band. p-d hybridization is found throughout the valence bands.

7487 **(DOE/ER/45069—T2) Mechanical properties of ceramics in the systems SIALON-Garnet and SIALON-Cordierite.** Chen, C.F.; Tien, T.Y. (Michigan Univ., Ann Arbor (USA). Dept. of Materials and Metallurgical Engineering). 1985. Contract FG02-84ER45069. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003864.

Additional high temperature mechanical property data were collected in this period. Samples were prepared by hot pressing at 1750°C for various length of time to develop β-SIALON grains with different sizes and aspect ratios. The composition of β-SIALON containing 10 equivalent % of aluminum (designate as β-10) containing 2 and 10 wt % of garnet and β-10 containing 10 wt % of cordierite were prepared. Specimens were hot pressed at 1750°C for one hour. Typical microstructure of these samples are shown. Size and aspect ratio of the β-SIALON grains in these samples are given. Temperature dependence of fracture strength and fracture toughness of these specimens were measured. The strength was measured by 4 point bending and toughness was measured by indentation bend.

7488 **(DOE/ER/45069—T3) Sintering and grain growth of silicon nitride ceramics in presence of reactive liquid.** Hwang, C.M.; Tien, T.Y. (Michigan Univ., Ann Arbor (USA). Dept. of Materials and Metallurgical Engineering). 1983. Contract FG02-84ER45069. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003865.

Sintering rate of compositions in the systems SIALON-Garnet ($Y_3Al_5O_{12}$) and SIALON - Cordierite ($2MgO.2Al_2O_3.5SiO_2$) and grain growth rate of the β-SIALON grains in these systems were studied. Compositions were sintered at 1400, 1600, 1700 and 1800°C for various length of time. The results indicated that the grain growth rate in presence of cordierite liquid is slower. The phase transformation rate of silicon nitride from α to β was also measured. The results showed that the transformation rate in the cordierite system is also slower. The results were interpreted in terms of liquid viscosity. The viscosity of the cordierite liquid is higher than that of the liquid in the garnet system.

7489 **(LBL—19425) Laser technique for evaluating the spall resistance of ceramic coatings.** Loh, R.L. (Lawrence Berkeley Lab., CA (USA)). May 1985. Contract AC03-76SF00098. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003995.

A laser technique for evaluating the spall resistance of ceramic coatings has been demonstrated. Additionally, in conjunction with a spalling criterion, indentation spalling tests on a ZnO/Si system and laser spalling tests on a ZrO_2/superalloy system have been correlated. Locally spalling occurs in the presence of sufficient compression in the coating and of an interface delamination that exceeds a critical size. Furthermore, spalling sizes are relatively insensitive to the initial delamination radius, and can be predicted from the critical buckling radius.

7490 **(N—85-26994/2/XAB) Breakway friction and dynamic friction/wear measurements of various ceramic materials from 25 C (75 F) to 650 C (1200 F). Final report.** Boes, D.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research Labs.). Sep 1984. 82p. NTIS, PC A05/MF A01.

This report describes the results of a program designed to evaluate the breakaway friction and dynamic friction/wear characteristics of materials having potential for use as load bearing components in a high-performance high-temperature heavy duty diesel engine. Ten candidate materials were selected, six of which were evaluated under all possible material combinations as both stationary as well as moving breakaway specimens. The remaining materials were evaluated either in the static mode against themselves and all other materials, or against themselves only. Experiments were performed at five temperatures up to 650 C (1200 F) and unit pressures of 700 kPa (100 lb/sq in.), 3500 kPa (500 lb/sq in.), and 7000 kPa (1000 lb/sq in.). Experimental results indicate that under dynamic conditions, four of the ten materials exhibited good to excellent friction/wear characteristics in various material combinations. These materials were: titanium carbide, silicon nitride, silicon carbide (reaction sintered), and Refel (SiC).

7491 **(SAND—85-2442C) Chemical vapor deposition of boron-based refractory solids.** Mullendore, A.W. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 11p. (CONF-850786—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003495.

From International conference on the physics and chemistry of boron and boron-rich borides; Albuquerque, NM, USA (29 Jul 1985).

This study of the growth morphology of boron carbide was undertaken to establish CVD conditions for single crystal growth. The initial emphasis was on preferred directional growth. The source gases chosen were BCl_3, CCl_4 and H_2 based on the prior investigations of Mierzejewska and Niemyski and those of Kevill, et al, both of which demonstrated the proclivity for directional growth of the deposits. The latter study included careful determinations of stoichiometry of the deposits as a function of temperature and vapor phase composition.

7492 **(SAND—85-2584C) Magnetic susceptibility of boron carbides.** Azevedo, L.J.; Venturini, E.L.; Emin, D.; Wood, C. (Sandia National Labs., Albuquerque, NM (USA); Jet Propulsion Lab., Pasadena, CA (USA)). 1985. Contract AC04-76DP00789. 4p. (CONF-850786—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003725.

From International conference on the physics and chemistry of boron and boron-rich borides; Albuquerque, NM, USA (29 Jul 1985).

We have measured the magnetic susceptibility of four compositions of boron carbides, B/sub x/C with x = 4, 6.5, 7.5 and 9. After analysis and corrections for small ferromagnetic impurities and diamagnetic contributions to the susceptibility we find that the spin concentration for all the samples is two orders of magnitude smaller than that determined by transport measurements on the same samples. We conclude that transport in these boron carbides is via spinless singlet bipolarons.

7493 **Hydrogen contribution to the heat capacity of single phase, face centered cubic scandium deuteride.** Moss, M.; Richards, P.M.; Venturini, E.L.; Gieske, J.H.; Graeber, E.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics;* **84**: No. 2, 956-963(15 Jan 1986).

The heat capacity at constant pressure, C/sub p/, of single-phase, face-centered cubic ScD/sub x/ (x = 1.75, 1.83, 1.91, and 1.99) was measured from room temperature to 950 K, and analyzed in terms of various contributions of the deuterium and metal constituents. Values ranged from approximately 40 to 80 J mol^{-1} K^{-1} with increasing temperature. The heat capacity at constant volume was assumed to be composed of lattice contributions from an acoustic vibrational mode, C/sup l/(a)/sub v/, and an optical vibrational mode, C/sup l/(o)/sub v/, plus an electronic contribution, C/sup e//sub v/. The acoustic part, C/sup l/(a)/sub v/, was evaluated as a Debye term with characteristic Debye temperatures calculated from measured values of temperature-dependent acoustic velocities and lattice constants. An isotope-adjusted Einstein temperature, derived from inelastic neutron scattering measurements on ScH_3, was used to find C/sup l/(o)/sub v/. The C/sup e//sub v/ term was evaluated from a published value of the electronic heat capacity constant for ScH_3 (assumed to be the same for ScD_3). Particular attention was paid to the dilation term, C/sup d/ = C/sub p/-C/sub v/, by evaluating it explicitly from the temperature-dependent volume expansion and elastic modulus.

7494 **Magnetic susceptibility study of boron carbides.** Azevedo, L.J.; Venturini, E.L.; Emin, D.; Wood, C. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review* [*Section*] *B: Condensed Matter;* **32**: No. 12, 7970-7972(15 Dec 1985). Contract AC04-76DP00789.

We have measured the magnetic susceptibility of several boron carbides, including B_4C, $B_{13}C_2$, and B_9C, over the temperature range 2—400 K with magnetic fields between 1 and 50 kOe. In general, the susceptibility follows a Curie law with a temperature-independent diamagnetic contribution. There is some ferromagnetic contribution to the susceptibility. However, the density of ferromagnetic impurities is considerably less in our samples than in commercial samples. The paramagnetic spin concentration is compared with the carrier concentration determined by transport measurements (conductivity, Hall effect, and Seebeck effect) on the same samples. The spin concentration is about 2 orders of magnitude smaller than the carrier concentration. We attribute the observed spins to defects and impurities. Thus, our results support the view that the charge carriers are spinless, small, singlet bipolarons.

7495 **Computational design of wear coatings.** Kramer, B.M.; Judd, P.K. (Laboratory for Manufacturing and Productivity, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 6, 2439-2444(Nov 1985). Contract AC02-84CE90225.

Quantitative models for the relative abrasive and chemical dissolution wear rates of potential tool coating materials are presented. Inputs to the models include the free energy of formation of the tool material, the excess free energies of solution of the constituent elements of the tool material in the workpiece, the hardness of the coating, and the cutting temperature. The models have been implemented on a VAX 11/750 minicomputer to allow screening of candidate materials for improved wear coatings. Sample calculations are included and suggest that it may be possible to develop coatings with significantly better performance than current titanium nitride coatings.

7496 **Diffusion of nickel through titanium nitride films.** Nowak, W.B.; Keukelaar, R.; Wang, W.; Nyaiesh, A.R. (Northeastern University, Boston, Massachusetts 02115). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 6, 2242-2245(Nov 1985).

TiN is among the candidates for thin film diffusion barriers on integrated circuit contacts. We have deposited titanium nitride (approximately TiN) and TiN+Sm films onto Ni substrates near room temperature by ion plating. Ti was e-beam evaporated in a chamber containing about 2.8 Pa (21 mTorr) of N_2 in the vicinity of the substrate. A plasma was excited between the substrate and a gas source-tube near the substrate by a combination of electrons from the e-beam (or backscattered from the Ti melt) and from an electric field generated by a constant current power supply (usually set at 100 mA) connected with negative polarity to the substrate. Deposition rates were 0.5 μm/min and the film thicknesses were 2 μm. The films are crystalline, slightly burnt gold in color, and are less dense and have an order of magnitude higher electrical resistivity than TiN produced by CVD methods. The addition of at least 12 at. % Sm produced amorphous films. The diffusion of Ni through these films was measured by energy dispersive analysis in a SEM. The amorphous material showed substantially lower diffusivities. Values of D_0 and Q, in the equation $D = D_0 \exp(-Q/RT)$, were determined to be 0.82 x 10^{-7} cm^2/s and 29 kcal/mol for crystalline TiN, and 0.56 cm^2/s and 67.3 kcal/mol for amorphous TiN+12 at. % Sm films. Because of film variation in structure and composition, these values vary. However, there is still a large improvement in the diffusion barrier property of TiN films by using amorphous films containing Sm. Ni diffuses very slowly into amorphous TiN+Sm at temperatures up to 655 °C. One must increase the temperature to 765 °C in order to observe diffusion rates comparable to crystalline TiN at 590 °C.

7497 **Chemical vapor deposition of erosion-resistant TiB_2 coatings.** Caputo, A.J.; Angelini, P.; Lackey, W.J.; Wright, I.G. (Oak Ridge National Laboratory, Metals and Ceramics Division, Oak Ridge, Tennessee). *Journal of the Electrochemical Society;* **132**: No. 9, 2274-2280(Sep 1985).

Erosion- and wear-resistant coatings are needed for numerous applications, including valve and pum components for coal liquefaction and gasification plants. Titanium diboride is unusually hard and stable and offers considerable promise for use in highly erosive and corrosive environments. We deposited TiB_2 coatings by hydrogen reduction of $TiCl_4$ and BCl_3. Our objective was to correlate process variables with coating structure and properties, with emphasis on obtaining coatings having high erosion resistance. We varied deposition temperatures from 750° to 1050°C and the $TiCl_4$ and BCl_3 flow rates. Commercial cemented carbides and experimental nickel-bonded TiB_2 were used as substrates. After structural characterization, the resistance of the deposited coatings to erosion

was determined by a hot coal-oil slurry impingement test. The deposition rate was very temperature dependent, ranging from 0.1 to 2.9 μm/min between 750° and 950°C. The surface of the coatings showed nodules increasing in size with temperature. The coatings were dense and adherent. The grain size varied with deposition conditions. Often, the grains were too small to resolve optically, but transmission electron microscopy showed the grain size to be very small (2-300 nm) and to increase with distance from the substrate. Electron microscopy and x-ray diffraction showed only single-phase TiB_2, and ion microprobe analysis revealed a constant Ti:B ratio across the coating thickness. Energy-dispersive fluorescence analyses showed more chlorine in coatings deposited at 800°C than in coatings deposited at higher temperatures. The Knoop microhardnesses of coatings deposited at 800° and 900°C were 15 and 33 GPa, respectively. Coatings deposited at 850°C or below eroded extensively (up to 30 μm deep craters during a 1h test), while those deposited at 900°C showed very little or no erosion (0-3 μm).

7498 **The vibrational spectra of the intermediate compounds in the system Y_2O_3-P_2O_5 and Gd_2O_3-P_2O_5.** Agrawal, C.C.; White, W.B. (Materials Research Laboratory, The Pennsylvania State University, University Park, PA). *Materials Research Bulletin;* **20**: No. 6, 697-703(Jun 1985).

The Infrared- and Raman-spectra of the intermediate compounds were studied for clues to their structural behavior as related to luminescence response. It was found that the degree of polymerization of PO_4 polyhedra increases in the phosphate-rich region and perhaps in the RE-oxide-rich region as well which was evident from the shift of stretching bands towards the higher energy side. Except in orthophosphates, the PO_4 polyhedra occupy more than one non-equivalent lattice site in all the phosphates.

7499 **Microcrack nucleation in ceramics subject to a phase transformation.** Fu, Y.; Evans, A.G.; Kriven, W.M. (University of California, Department of Materials Science and Mineral Engineering, Berkeley, California). *Journal of the American Ceramic Society;* **67**: No. 9, 626-630(Sep 1984).

The nucleation of microcracks from twins formed in monoclinic ZrO_2 was analyzed. The twin formation was shown to result in large tensile stress concentrations capable of spontaneous microcrack nucleation. The role of interface dislocations in microcrack nucleation was also considered.

7500 **Crystallization of a glass-ceramic by epitaxial growth.** Headley, T.J.; Loehman, R.E. (Sandia National Laboratories, Albuquerque, New Mexico). *Journal of the American Ceramic Society;* **67**: No. 9, 620-625(Sep 1984).

The crystallization mechanism in a modified Li_2O-Al_2O_3-SiO_2 glass containing P_2O_5 nucleating agent was investigated by transmission electron microscopy, X-ray diffraction, and differential thermal analysis. During an initial 1000°C treatment P_2O_5 and Li_2O react to precipitate Li_3PO_4 crystallites. At lower temperatures cristobalite, lithium metasilicate, and lithium disilicate crystallize by epitaxial growth on those Li_3PO_4 crystallites. Crystallographic orientation relations for epitaxy were determined by electron diffraction, and lattice misfits were found to be in the range -5.3 to +3.8%. These results provide the first direct proof that glass-ceramics can crystallize by epitaxial growth on heterogeneous nuclei formed from intentionally added nucleating agents.

3603 COMPOSITE MATERIALS

REFER ALSO TO CITATION(S) 8104

7501 **(PB—85-205920) Influence of ply cracks on fracture strength of graphite/epoxy laminates at 76 K.** Kriz, R.D. (National Bureau of Standards, Boulder, CO (USA). Fracture and Deformation Div.). 1984. 15p. NTIS.

Quasi-isotropic laminates were fabricated from graphite/epoxy and quasi-statically loaded in tension at 76 K until fracture occurred. Fibers in 0-deg plies carry the largest portion of the tensile load; the weaker 90- and 45-deg plies crack at loads much lower than fracture strength. The effect of ply cracks on fracture of load-bearing 0-deg plies was examined to understand how defects affect laminate strength. A generalized plane-strain finite-element model was used to predict stress gradients in the 0-deg ply near the crack tip. Variations in residual stress caused by changes in temperature and absorbed moisture were included in the analysis.

7502 **(SAND—85-2607C) LPCVD tungsten deposition on porous silicon for formation of buried conductors.** Tsao, S.S.; Blewer, R.S. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 12p. (CONF-851217—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003713.

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

We report results on the feasibility of forming buried conductors under single crystal silicon using low pressure chemical vapor deposition of tungsten on the interal surfaces of porous silicon. The infiltration of tungsten into the pores depends on the porous silicon porosity, and on tungsten deposition process parameters such as deposition duration, total deposition pressure, and carrier gas species. The resulting tungsten-porous silicon layers were characterized by transmission and scanning electron microscopy, Rutherford backscattering and x-ray spectroscopy and four-point probe resistivity measurements.

7503 **(UCID—19765) Matrix-dominated time-dependent deformation and damage of graphite/epoxy composite. Experimental data under creep and recovery. Final report, Jan. 1981-Sep. 1982.** Wu, E.M.; Sanchez, R.J.; Nguyen, N.Q. (Lawrence Livermore National Lab., CA (USA)). Jun 1983. Contract W-7405-ENG-48. 394p. NTIS, PC A17/MF A01; 1; GPO Dep. File Number DE86003523.

The objective of this report is to disseminate experimental data of matrix-dominated time-dependent deformation and time-dependent damage in graphite-epoxy composite. The composite specimens were +-45° T300/5208 laminates tested in tension under creep and creep-recovery with complete instrumentation for stress, strain, and time recordings. Experimental data were recorded and archived in digital form. Polynomial series are fitted to the experimental data for compilation, dissemination and future retrieval.

3604 POLYMERS AND PLASTICS

REFER ALSO TO CITATION(S) 6993, 7750

7504 **(BDX—613-3358) Evaluation of heat-shrinkable polyolefin tubing. Final report.** Larsen, F.N. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Dec 1985. Contract AC04-76DP00613. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004381.

Polyolefin heat-shrinkable tubing was evaluated for parameters leading to splitting of the tubing. It was concluded that temperature cycling from ambient to 250°F, which is above the polymer crystalline melt of 218°F induces stresses which cause splitting of the tubing. It was also determined that as-received (unshrunk) tubing is more susceptible to notch sensitivity and splitting than the shrunk tubing after processing. Lowering the thermal exposure temperature to 160°F eliminated the splitting problem. Chemical characterization of the straight tubing and a molded boot material showed similar composition regarding flame retardants and additives. The molded boot material should be an acceptable substitute for the tubing from an aging and compatibility viewpoint.

7505 **^{29}Si nuclear magnetic resonance study of plasma-polymerized hexamethyldisiloxane.** Assink, R.A.; Hays, A.K.; Bild, R.W.; Hawkins, B.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 6, 2629-2633(Nov 1985). Contract AC04-76DP00789.

The structure of plasma-polymerized hexamethyldisiloxane (PP-HMDSO) was studied by ^{29}Si nuclear magnetic resonance (NMR) using magic angle spinning and cross-polarization techniques. Spectra of the PP-HMDSO were recorded before and after it had been subjected to successive heat treatments in air at 100, 200, and 300 °C. The spectra exhibit major peaks at +11 ppm, -18

ppm, -55 to -64 ppm, and -99 to -106 ppm with respect to tetramethylsilane. These shifts correspond to silicon bonded to one, two, three, and four oxygens, respectively. The broadness of the tri- and tetrafunctional silicon peaks is attributed to SiOH or $SiOCH_3$ functional groups in addition to the normal SiOSi moieties. Minor peaks at -5 and -33 ppm are attributed to mono- and difunctional silicons in which one of the methyl groups has been replaced by a hydrogen. As the material is heat treated there is a tendency for the PP-HMDSO to form additional silicon—oxygen bonds. Spectra simulations show that the oxygen content increases from 16 to 30 wt. % during the course of the heat treatment. The silicon to oxygen weight percent ratios measured by NMR spectra simulation and neutron activation analysis are comparable and decrease monotonically as the heat treatment progresses.

3606 OTHER MATERIALS

REFER ALSO TO CITATION(S) 6993, 7010, 7377, 7438, 7500

7506 **(BNL—36660) Effects of acid deposition on portland cement concrete.** Webster, R.P.; Kukacka, L.E. (Brookhaven National Lab., Upton, NY (USA)). May 1985. Contract AC02-76CH00016. 24p. (CONF-8506213—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002506.

From State-of-the-art symposium on degradation of materials due to acid rain; Arlington, VA, USA (17 Jun 1985).

Presented are the results of a program, sponsored by the Environmental Protection Agency, conducted to determine the state-of-the-art knowledge pertaining to the effects of acid deposition on the properties of portland cement concrete structures (PCC). Information was collected from a computerized literature survey, interviews, and replies to mail and telephone inquiries addressed to cement and concrete researchers and to governmental agencies and private firms active in the maintenance and restoration of concrete structures. In general, the study revealed very little qualitative or quantitative information on the effects of acid deposition on PCC structures. The rate of deterioration of reinforced PCC structures in polluted areas, however, appears to be increasing, and available information makes it readily apparent that acids and acid waters significantly affect the durability of concrete, and that SO_2, NO/sub x/, and HCl accelerate the corrosion of reinforcing steel. On the basis of this evidence, it was recommended that an experimental test program, consisting of both laboratory and field tests, be developed and implemented to quantitatively measure the effects of acid deposition on PCC structures. 51 refs.

7507 **(CONF-841157—100) Modeling of undercooling, nucleation, and multiple phase front formation in pulsed laser melted amorphous silicon.** Wood, R.F.; Geist, G.A.; Solomon, A.D.; Lowndes, D.H.; Jellison, G.E. Jr. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002192.

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

Recently available experimental data indicate that the solidification of undercooled molten silicon prepared by pulsed laser melting of amorphous silicon is a complex process. Time-resolved reflectivity and electrical conductivity measurements provide information about near-surface melting and suggest the presence of buried molten layers. Transmission electron micrographs show the formation of both fine and large-grained polycrystalline regions if the melt front does not penetrate through the amorphous layer. We have carried out extensive calculations using a newly developed computer program based on an enthalpy formulation of the heat conduction problem. The program provides the framework for a consistent treatment of the simultaneous formation of multiple states and phase-front propagation by allowing material in each finite-difference cell to melt, undercool, nucleate, and solidify under prescribed conditions. Calculations indicate possibilities for a wide variety of solidification behavior. The new model and selected results of calculations are discussed here and comparisons with recent experimental data are made.

7508 **(CONF-8510168—3) Effect of microstructure on the arsenic profile in implanted silicon.** Coghlan, W.A.; Rhee, M.H.; Williams, J.M.; Streit, L.A.; Williams, P. (Oak Ridge National Lab., TN (USA); Arizona State Univ., Tempe (USA). Dept. of Mechanical and Aerospace Engineering; Arizona State Univ., Tempe (USA). Center for Solid State Science). Oct 1985. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003272.

From TMS/AIME fall meeting; Toronto, Canada (13 Oct 1985).

According to an irradiation damage model, the profile of an implanted ion at temperature great enough for diffusion to occur will depend on the sink density in the material. To test this model, pure silicon wafers were prepared with high and low dislocation densities. These wafers were implanted with about 5×10^{19} As^{+2}/m^2 at 77°K, 300°C, and 600°C. After implanting the profiles were measured using Rutherford backscattering spectroscopy and secondary ion mass spectroscopy. The observed spreading of the As-profile contradicts initial theoretical predictions. Further speculation is presented to explain the differences.

7509 **(DP-MS—85-65) Nuclear waste vitrification: the geology connection.** Wicks, G.G. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 19p. (CONF-850755—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003948.

From Symposium on physics and chemistry of glass and glassmaking; Alfred, NY, USA (30 Jul 1985).

Located at the Savannah River Plant (SRP) site are approximately 30 million gallons of high-level radioactive waste. Starting in 1989, this waste will be removed from temporary storage tanks and immobilized in borosilicate glass. The resulting waste glass product will ultimately be transported to federal repositories. At the geologic repository site, the waste glass will then be placed approximately one-half mile underground and become an important component of a multibarrier isolation system, aimed at permanently disposing of the radioactive material. Nowhere in this waste disposal scenario is it more important to have good waste form performance than in the final resting place of the product, that of the geologic repository. In order to assess and understand waste glass performance in the geologic environment, a multiphase experimental program is in progress at Savannah River. An overview of experimental efforts along with selected data are presented. 15 refs., 7 figs., 1 tab.

7510 **(GEND—053) EPICOR-II resin degradation results from first resin samples of PF-8 and PF-20.** McConnell, J.W. Jr.; Sanders, R.D. Sr. (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1985. Contract AC07-76ID01570. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003799.

The 28 March 1979 accident at Three Mile Island Unit 2 released approximately 560,000 gallons of contaminated water to the Auxiliary and Fuel Handling Buildings. The water was decontaminated using a demineralization system called EPICOR-II developed by Epicor, Inc. The Low-Level Waste Data Base Development - EPICOR-II Resin/Liner Investigation Project is studying the chemical and physical conditions of the synthetic ion exchange resins found in several EPICOR-II prefilters. This report summarizes results and analyses of the first sampling of ion exchange resins from EPICOR-II prefilters PE-8 and -20. Results are compared with baseline data from tests performed on unirradiated Epicor, Inc. resins to determine if degradation has occurred due to the high internal radiation dose received by the EPICOR-II resins. Results also are compared with recent findings on resin degradation by Battelle Columbus Laboratories and Brookhaven National Laboratory. Analyses comparing test results of resins from EPICOR-II prefilters PF-8 and -20 with unirradiated resins obtained from Epicor, Inc. show resin degradation has occurred in some of the EPICOR-II resins examined. The mechanism of degradation is compared with work of other researchers and is consistent with their findings. The strong acid cation resins (divinylbenzene, styrene base structure) are losing effective cross-linking along with scission of functional groups and are experiencing first an increase

and eventually a decrease in total exchange capacity as the absorbed radiation dose increases. The phenolic cation resins (phenol-formaldehyde base structure) show a loss of effective cross-linking and oxidation of the polymer chain. Analyses of resins removed from EPICOR-II prefilters PF-8 and -20 over the next several years should show a further increase in degradation.

7511 **(LBL—20184) Influence of dangling bond defects on recombination in a-Si:H.** Dersch, H.; Skumanich, A.; Amer, N.M. (Lawrence Berkeley Lab., CA (USA)). Jun 1985. Contract AC03-76SF00098. 5p. (CONF-8509201—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002874.

From 11. international conference on amorphous semiconductors; Rome, Italy (2 Sep 1985).

Time resolved photoinduced absorption (PIA) and steady state photoconductivity experiments (PC) are used to study recombination processes in electron-irradiated hydrogenated amorphous silicon (a-Si:H). Defect densities measured by ESR range from 5 x 10^{15}/cm^3 to 10^{19}/cm^3. It is found that while increasing the dangling bond density reduces the PC, the PIA decay rate increases. The results are discussed in the context of a recombination model where the defect density determines whether the carriers recombine through a fast bimolecular or a slower monomolecular process.

7512 **(LBL—20328) Resonant Raman scattering as a probe of intrinsic defects in GaAs.** Berg, R.S. (Lawrence Berkeley Lab., CA (USA)). Oct 1985. Contract AC03-76SF00098. 144p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86004007.

Raman scattering measurements were performed on GaAs samples that have been irradiated with either high energy electrons or neutrons. New, relatively sharp peaks were observed in the Raman spectra of the irradiated samples and are attributed to vibrational modes of a specific point defect created by the irradiation. On the basis of annealing experiments, one of these modes is most likely associated with an As vacancy. The observed polarization dependence suggests that this can be a "breathing" vibration of the atoms surrounding the vacancy. Experiments were performed that measured the lineshape of the enhancement of the Raman cross section of both the intrinsic and extrinsic modes near the band gap of GaAs using a tunable near infrared laser. It was observed that the enhancement of the defect-induced modes was strong relative to the enhancement of the allowed TO phonon, which itself exhibits a strong enhancement. The observed enhancement lineshape can be explained by assuming that the scattering involving the defect-induced modes occurs via a fourth-order process. During this process quasi-momentum conservation is relaxed when electrons or holes scatter elastically from defects. It is concluded that the strong resonant enhancement occurs when the vibrational modes involved have a component that is well localized around a defect.

7513 **(PNL—5577-1) Fabrication and characterization of MCC approved testing material - ATM-1 glass.** Wald, J.W. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003795.

The Materials Characterization Center Approved Testing Material ATM-1 is a borosilicate glass that incorporates nonradioactive constituents and uranium to represent high-level waste (HLW) resulting from the reprocessing of commercial nuclear reactor fuel. Its composition is based upon the simulated HLW glass type 76-68 to which depleted uranium has been added as UO_2. Three separate lots of ATM-1 glass have been fabricated, designated ATM-1a, ATM-1b, and ATM-1c. Limited analyses and microstructural evaluations were conducted on each type. Each lot of ATM-1 glass was produced from a feedstock melted in an air atmosphere at between 1150 to 1200°C and cast into stress annealed rectangular bars. Bars of ATM-1a were nominally 1.3 x 1.3 x 7.6 cm (~36 g each), bars of ATM-1b were nominally 2 x 2.5 x 17.5 cm (~190 g each) and bars of ATM-1c were nominally 1.9 x 1.9 x 15 cm (~170 g each). Thirteen bars of ATM-1a, 14 bars of ATM-1b, and 6 bars of ATM-1c were produced. Twelve random samples from each of lots ATM-1a, ATM-1b, and ATM-1c were analyzed. The concentrations (except for U and Cs) were obtained by Inductively-Coupled Argon Plasma Atomic Emission Spectroscopy analysis. Cesium analysis was performed by Atomic Absorption Spectroscopy, while uranium was analyzed by Pulsed Laser Fluorometry. X-ray diffraction analysis of four samples indicated that lot ATM-1a had no detectable crystalline phases (<3 wt %), while ATM-1b and ATM-1c contained ~3 to 5 wt % iron-chrome spinel crystals. These concentrations of secondary spinel component are not considered uncommon. Scanning electron microscopy examination of fracture surfaces revealed only a random, apparently crystalline, second phase (1-10 μm diam) and a random distribution of small voids or bubbles (~1 μm nominal diam).

7514 **(PNL—5654) Results from the long-term interaction and modeling of SRL-131 glass with aqueous solutions.** Strachan, D.M.; Pederson, L.R.; Lokken, R.O. (Pacific Northwest Labs., Richland, WA (USA)). Nov 1985. Contract AC06-76RL01830. 117p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86003800.

Leaching studies on SRL-131 simulated defense waste glass have been carried out for a duration of two years. This glass contained nonradioactive elements and depleted uranium to simulate the waste content. The leachants used in this study were deionized water, a sodium bicarbonate/silicic acid solution (silicate water), a synthetic groundwater, and a high ionic strength K-Mg-Na-Cl brine. Two temperatures were used: 40°C and 90°C. The long-term results were in fair agreement with modeling calculations performed using the PHREEQE geochemical code. The leachability of SRL-131 glass from results up to two years followed the trend: deionized water > silicate water > synthetic groundwater > salt brine at 40°C and deionized water ≃ synthetic groundwater > silicate water > salt brine at 90°C. Solid state analyses are reported along with an Appendix containing a complete data set.

7515 **(SAND—85-1177C) Variations in the refractive index of the near-surface region of low energy hydrogen ion bombarded silicon.** Pettit, R.B.; Panitz, J.K.G. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 17p. (CONF-851217—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003500.

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

Using ellipsometric analysis, the complex index of refraction of low-energy, hydrogen ion bombarded, [100] single-crystal silicon was measured as a function of distance from the bombarded surface. The bombardment conditions were a 1600 eV hydrogen beam produced by a Kaufman ion source, 1.4 mA/cm^2 flux, 2 x 10^{18} ions/cm^2 fluence and 275°C bulk silicon temperature. These conditions are comparable to the conditions generally reported to result in a substantial increase in the electrical conductivity of polycrystalline silicon solar cell material. Results indicate that the real and imaginary parts of the refractive index of the ion bombarded surface region approach that of the unbombarded substrate at a depth of 50 nm. The refractive index of about the first 10 nm of ion bombarded material is strongly dependent on the bombardment conditions. Variations in the imaginary part of the refractive index indicate that approximately 10% of incident radiation is absorbed by the first 50 nm of modified material.

7516 **(SAND—85-1333C) Epitaxial formation of rare earth silicides by rapid annealing.** Knapp, J.A.; Picraux, S.T. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 12p. (CONF-851217—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003568.

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

Rapid electron beam and lamp heating have been used to form thin epitaxial films of rare-earth silicides by reacting overlayers of the rare earths with (111) Si substrates. Of the metals Y, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu, all but Gd are found to form epitaxial silicide layers by rapid solid-phase reaction, while silicides of Gd, Dy, Tm, Yb and Lu have been formed epitaxially by liquid phase reaction. For all but Er this is the first demonstration of epitaxial growth on Si. Details obtained from ion beam channeling analysis and transmission electron microscopy confirm the expected epitaxial structure and also show that the Si vacancies in the silicide

form an ordered superlattice, rather than a random array as had been assumed before.

7517 **(SAND—85-1348C) Nucleation of internal melt during pulsed laser irradiation.** Peercy, P.S.; Thompson, M.O.; Tsao, J.Y.; Poate, J.M. (Sandia National Labs., Albuquerque, NM (USA); Bell Labs., Murray Hill, NJ (USA)). 1985. Contract AC04-76DP00789. 6p. (CONF-851217—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003726.

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

Real-time measurements of the molten layer thickness and simulataneous measurements of the melt duration at the surface reveal that melt nucleates internally when Si implanted with low solid-solubility impurities such as In is melted with a 30 ns laser pulse at 694 nm. Internal nucleation of melt was observed for all energy densities examined. Furthermore, at energy densities insufficient to melt the entire amorphous layer, internal nucleation of melt is followed by an explosive-like process in which a buried molten layer propagates toward the irradiated surface.

7518 **(SAND—85-1349C) Measurement of melt and solidification dynamics during pulsed laser irradiation.** Peercy, P.S. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 58p. (CONF-8509150—2). NTIS, PC A04/MF A01; GPO Dep. File Number DE86002589.

From NATO advanced study institute; San Miniato, Italy (2 Sep 1985).

Simultaneous measurements of the transient conductance and the time-dependent surface reflectance are reviewed. These real-time measurements have been applied in Si and Si-based alloys. Studies in silicon on sapphire demonstrate that melt initiates at the surface and propagates to some depth, whereupon the motion of the liquid/solid interface reverses, the material solidifies, and the interface returns to the surface. Comparison of solidification velocities for bulk Si with numerical heat flow calculations demonstrates that the laser melting process can be understood on the basis of a purely thermal model under equilibrium conditions. In amorphous Si, the transient conductance measurements permits the melting temperature of the amorphous phase to be determined. The melting temperature of amorphous Si is reduced by 225°K relative to the melting temperature of crystalline Si, and explosive crystallization of amorphous Si is observed to be mediated by a thin molten layer that propagates at ~14 m/s. The reduced melting temperature of amorphous Si is confirmed by studies on Si-Ge alloys. Measurements of the melt dynamics with short (~3 ns) pulse irradiation are used to estimate the velocity-undercooling relationship in Si. In Si containing metastable concentrations of substitutional As, the effect of As on the solidification velocity permits the metastable melting temperatures to be determined. Combined transient conductance and surface reflectance studies permit examination of internal nucleation of melt and surface nucleation of solid. These buried molten layers lead to novel microstructures. Recent extensions of the technique to metallic systems are summarized.

7519 **(SAND—85-1598C) Nitrogen in crystalline Si.** Stein, H.J. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 14p. (CONF-851217—8). NTIS, PC A02. File Number DE86003714.

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

Use of N doping, N gas ambients and N implantation in Si processing has stimulated study of the incorporation and behaviour of N in Si. Studies of N-implanted Si and comparisons with melt-doped Si have shown that N pairing is the dominant mode for bonding of N into crystalline Si for a wide range of processing conditions. Studies have also shown that laser annealing quenches a small percentage of implanted N into a substitutional site. Nitrogen diffusion and aggregation have been shown to occur in N-implanted Si upon furnace annealing at temperatures >700°C and there is a simultaneous formation of shallow donors. Interactions between N and other impurities occur in both as-grown and ion-implanted Si. Additional studies are needed to describe more fully the electrical and structural consequences of N-N, N-impurity and N-defect interactions in Si.

7520 **(SAND—85-2104C) Effects of calcining parameter variations on 95/5 PZT ceramics.** Botsford, B.A. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1985. Contract AC04-76DP00789. 28p. (CONF-8511132—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003173.

From DOE ceramics conference; Livermore, CA, USA (20 Nov 1985).

This document is a collection of graphs on the calcination of PZT and related ceramics. (DLC)

7521 **(SAND—85-2156C) Structure of random silicates: polymers, colloids, and porous solids.** Schaefer, D.W.; Keefer, K.D. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 8p. (CONF-850797—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003496.

From 6. international symposium on 'fractals in physics'; Trieste, Italy (9 Jul 1985).

Small angle x-ray scattering and light scattering are used to characterize structures grown by random processes within the silica system. Dense colloids, rough colloids, and branched polymers are grown by polymerization in solution. Supermolecular structures are also studied, including gels, colloidal liquids, and aggregates.

7522 **(UCRL—15675) Epitaxial overgrowth of Si on SiO_2 film.** Yue, A.S. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Mar 1985. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002597.

The novel approach to increase the performance of semiconductor devices is proposed. This approach is based on the concept of three-dimensional device fabrication where a single-crystalline Si layer is electrically isolated from a similar Si layer by a SiO_2 film. The growth of this single-crystalline Si layer is accomplished by an epitaxial growth of Si on slots of the seed region of a Si substrate bordered with a SiO_2 film and the overgrowth of Si on top of the SiO_2 surface by the CVD technique. The single-crystallinity of the epilayer has been revealed by the presence of Kikuchi lines on its surface.

7523 **X-ray refractive index: A tool to determine the average composition in multilayer structures.** Miceli, P.F.; Neumann, D.A.; Zabel, H. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana—Champaign, Urbana, Illinois 61801). *Applied Physics Letters;* **48**: No. 1, 24-26(6 Jan 1986). Contract AC02-76ER01198.

We present a novel and simple method to determine the average composition of multilayers and superlattices by measuring the x-ray refractive index. Since these modulated structures exhibit Bragg reflections at small angles, by using a triple axis x-ray spectrometer we have accurately determined the peak shifts due to refraction in GaAs/Al/sub x/Ga/sub 1-x/As and Nb/Ta superlattices. Knowledge of the refractive index provides the average fractional composition of the periodic structure since the refractive index is a superposition of the refractive indices of the atomic constituents. We also present a critical discussion of the method and compare the values of the average fractional composition obtained in this manner to the values obtained from the lattice parameter change in the GaAs/Al/sub x/Ga/sub 1-x/As superlattices due to the Al.

7524 **Observation of molecular reorientation at a two-dimensional-liquid phase transition.** Rasing, T.; Shen, Y.R.; Kim, M.W.; Grubb, S. (Department of Physics, University of California, Berkeley, California and Center for Advanced Materials, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review Letters;* **55**: No. 26, 2903-2906(23 Dec 1985). Contract AC03-76SF00098.

The structure of a monolayer of pentadecanoic acid near the liquid-expanded—liquid-condensed phase transition at a water-air interface is studied by optical second-harmonic generation. The results show that this transition is accompanied by a reorientation of the molecules and that the two phases are separated by an inhomogeneous coexistence region on the isotherms.

7525 Atomic geometry of the 2 x 2 GaP(111) surface. Xu, G.; Hu, W.Y.; Puga, M.W.; Tong, S.Y.; Yeh, J.L.; Wang, S.R.; Lee, B.W. (Department of Physics and Laboratory for Surface Studies, University of WisconsinMilwaukee, Milwaukee, Wisconsin 53201). *Physical Review* [*Section*] *B: Condensed Matter;* **32**: No. 12, 8473-8476(15 Dec 1985). Contract FG02-84ER45076.

Integral and fractional order beam low-energy electron-diffraction intensity-voltage (I-V) data have been taken on a bombardment-annealed GaP(111)-(2 x 2) surface. We have compared these data with calculated I-V curves using a dynamical multiple scattering theory and found very good agreement for the following model: One out of every four Ga surface atoms is missing and the surface Ga-P bilayer is almost coplanar. Surface and deeper layer atoms undergo vertical and lateral displacements from bulk positions. Similar results in other systems suggest that the vacancy model applies on the (111) face of many compound semiconductors.

7526 Theoretical study of stacking faults in silicon. Chou, M.Y.; Cohen, M.L.; Louie, S.G. (Department of Physics, University of California, Berkeley, California 94720 and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **32**: No. 12, 7979-7987(15 Dec 1985). Contract AC03-76SF00098.

The intrinsic and extrinsic stacking faults along the [111] direction in silicon are studied within the local-density-functional approach with ab initio pseudopotentials using a plane-wave basis set. The stacking-fault energy is obtained from first principles and is found to be in reasonably good agreement with experimental values. Electronic defect states are found within the energy gap. The defect state with energy 0.1 eV above the valence-band maximum is consistent with photoluminescence data. The electron density near the fault is found to deviate only slightly from the perfect crystal. The Hellmann-Feynman force theorem is used to study the forces on atoms near the fault and to determine the resulting structural relaxations. It is found that the interplanar separations increase by about 1% to achieve vanishing forces. This relaxation does not affect appreciably the stacking-fault energy, the eigenvalues, and other electronic properties.

7527 Surface quenching of optically generated carriers in thin-film hydrogenated amorphous silicon: Picosecond transient-grating experiments. Newell, V.J.; Rose, T.S.; Fayer, M.D. (Department of Chemistry, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *B: Condensed Matter;* **32**: No. 12, 8035-8040(15 Dec 1985). Contract FG03-84ER13251.

Subnanosecond-timescale transient-grating experiments are used to investigate the dynamics of optically generated charge carriers in thin-film hydrogenated amorphous silicon (a-Si:H) at room temperature. By examining the time dependence of the transient-grating signal as a function of fringe spacing for small fringe spacing, the diffusion constant in the plane of the film (D/sub X/) is determined. At large fringe spacing, the grating decay becomes independent of fringe spacing and is highly nonexponential. The functional form and rate of the large-fringe-spacing decay change with sample thickness. A model for the effect of surface quenching on the transient-grating decay is presented. The calculations are in good agreement with the data and yield a diffusion constant (D/sub perpendicular/) for motion perpendicular to the thin-film plane. D/sub perpendicular/ = 0.4 x 10^{-2} cm^2/sec, while D/sub X/ = 1.0 x 10^{-2} cm^2/sec.

7528 Growth and characterization of GaAs/Ge epilayers grown on Si substrates by molecular beam epitaxy. Sheldon, P.; Yacobi, B.G.; Jones, K.M.; Dunlavy, D.J. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Applied Physics;* **58**: No. 11, 4186-4193(1 Dec 1985). Contract AC02-83CH10093.

Epitaxial GaAs/Ge films are grown by molecular beam epitaxy (MBE) on Si substrates. The effect of various MBE growth conditions on the sample morphology, the defect density, and the optical properties of GaAs and Ge epilayers is examined. Scanning electron microscopy, plan-view and cross-sectional transmission electron microscopy, reflection high-energy electron diffraction, and photoluminescence are used to characterize epitaxial layers. It is found that the defect density decreases with increasing epilayer thickness. This is due to an annihilation process that affects both threading dislocations and stacking faults. The substrate temperature during Ge growth is found to affect the properties of both the Ge and GaAs films. GaAs surface morphology degrades and the stacking fault density increases at high Ge buffer-layer substrate temperatures; however, the threading dislocation density remains unchanged. Variations in growth conditions are correlated with defect densities and luminescence efficiencies to determine material quality and optimize growth conditions.

7529 Electrical conductivity of p-type $CuInSe_2$ thin films. Datta, T.; Noufi, R.; Deb, S.K. (Physics and Astronomy Department, University of South Carolina, Columbia, South Carolina 29209). *Applied Physics Letters;* **47**: No. 10, 1102-1104(15 Nov 1985). Contract AC02-83CH10093.

The dark ohmic conductivity $\sigma(T)$ of several p-type $CuInSe_2$ thin films of different compositions was measured in vacuum in the temperature range 100—350 K. The room-temperature resistivity of Cu-rich, highly conducting films and the Cu-poor, highly resistive films varied by seven orders of magnitude. For the most conducting films (Cu:In>1, rho~0.1 Ω cm), $\sigma(T)$ was pseudometallic, i.e., $d\sigma/dT <$ or ≈ 0. The Cu-poor films exhibited a thermally activated conductivity, i.e., $\sigma(T) = \sigma_0 \exp(-E/kT)$, over a considerable temperature range. The data of post-deposition anneal in air and subsequently in hydrogen are in excellent agreement with Meyer—Neldel type of conduction, i.e., $\sigma(T) = \sigma_{00} \exp(-E/kT_0)\exp(E/kT)$. We attribute this behavior to the compensation of the films by oxygen.

7530 Pulsed laser damage to optical fibers. Allison, S.W.; Gillies, G.T.; Magnuson, D.W.; Pagano, T.S. (Martin Marietta Energy Systems, Inc., Post Office Box P, Oak Ridge, Tennessee 37831). *Applied Optics;* **24**: No. 19, 3140-3145(1 Oct 1985). Contract AC05-84OR21400.

This paper describes some observations of pulsed laser damage to optical fibers with emphasis on a damage mode characterized as a linear fracture along the outer core of a fiber. Damage threshold data are presented which illustrate the effects of the focusing lens, end-surface preparation, and type of fiber. An explanation based on fiber-beam misalignment is given and is illustrated by a simple experiment and ray trace.

7531 Antireflective graded index silica coating, method for making. Yoldas, B. E.; Partlow, D. P. (to The United States of America as represented by the United States Department of Energy). US Patent 4,535,026. 13 Aug 1985. Filed date 29 Jun 1983. vp.

PAT-APPL-509118.

Antireflective silica coating for vitreous material is substantially non-reflecting over a wide band of radiations. This is achieved by providing the coating with a graded degree of porosity which grades the index of refraction between that of air and the vitreous material of the substrate. To prepare the coating, there is first prepared a silicon-alkoxide-based coating solution of particular polymer structure produced by a controlled proportion of water to alkoxide and a controlled concentration of alkoxide to solution, along with a small amount of catalyst. The primary solvent is alcohol and the solution is polymerized and hydrolized under controlled conditions prior to use. The prepared solution is applied as a film to the vitreous substrate and rapidly dried. It is thereafter heated under controlled conditions to volatilize the hydroxyl radicals and organics therefrom and then to produce a suitable pore morphology in the residual porous silica layer. The silica layer is then etched in order to enlarge the pores in a graded fashion, with the largest of the pores remaining being sufficiently small that radiations to be passed through the substrate are not significantly scattered. For use with quartz substrates, extremely durable coatings which display only 0.1% reflectivity have been prepared.

7532 **Transient-enhanced diffusion during furnace and rapid thermal annealing of ion-implanted silicon.** Pennycook, S.J.; Holland, O.W.; Naragan, J. (Oak Ridge National Laboratory, Solid State Division, Oak Ridge, Tennessee). *Journal of the Electrochemical Society;* **132**: No. 8, 1962-1968(Aug 1985).

A transient-enhanced diffusion has been observed during the furnace or rapid thermal annealing of ion-implanted silicon. We have studied this transient in detail and show that, for doses of Group V dopants sufficient to amorphize the silicon, it arises from the trapping of interstitials by dopant atoms during implantation. These are retained during solidphase-epitaxial (SPE) growth, but can be released by additional thermal processing to cause the observed transient and the formation of a band of extended defects. We have measured the enhanced diffusion coefficients and the duration of the transient for Sb-implanted Si by careful furnace annealing experiments. We obtain general expressions which predict the effects of the transient during any thermal processing based on SPE growth (furnace, CW laser, or rapid thermal annealing). We show that there is no analogous mechanism of vacancy trapping by Group III elements.

7533 **The crystal structure of a nonstoichiometric nasicon.** Rudolf, F.; Clearfield, A.; Jorgensen, J.D.; Subramanian, M.A. (Department of Chemistry, Texas A & M University, College Station, Texas). *Materials Research Bulletin;* **20**: No. 6, 643-651(Jun 1985).

The crystal structure of a nonstoichiometric NASICON prepared from a hydrothermally synthesized precursor phase was solved by means of Xray powder and neutron powder diffraction methods. The NASICON phase is monoclinic with unit cell parameters, from Rietveld refinement of the neutron data, of a = 15.6209(8), b = 9.0326(5), c = 9.2172(5)A, β = 123.67(1)A, V = 1082.5A^3. The space group is C2/c with Z = 4. The structure is essentially that proposed earlier by Hong, but the nonstoichiometry results from replacement of part of the Zr^{4+} by Na^+. Refinement of site occupancies coupled with the requirement of overall charge balance yields the formula Na /sub 2.88/ (Na /sub 0.32/ Zr /sub 1.68/)Si /sub 1.84/ P /sub 1.16/ O /sub 11.54/ which also agrees well with analytical data. Only 20% of the Na1 sites are occupied, but 80% of the Na3 sites are filled. This structure provides a framework from which to rationalize the many reports in the literature that NASICON can only be prepared with difficulty by high temperature solid state reactions.

7534 **Thermochemistry of charge-coupled substitutions in silicate glasses: The systems M /SUB 1/n/ /SUP n+/ $A1O_2$-SiO_2 (M = Li, Na, K, Rb, Cs, Mg, Ca, Sr, Ba, Pb).** Roy, B.N.; Navrotsky, A. (Arizona State University, Department of Chemistry, Tempe, Arizona). *Journal of the American Ceramic Society;* **67**: No. 9, 606-610(Sep 1984).

Enthalpies of solution of framework aluminosilicate glasses xM /SUB 1/n/ /SUP n+/ AlO_2-(1-x)SiO_2(M = Cs, Rb, K, Na, Li, Ba, Pb, Sr, Ca, Mg) in molten 2PbO X B_2O_3 near 973 K were measured. The sequence above represents increasing ability of the nonframework cation M to bond to the bridging oxygen. In that sequence, the enthalpy of the substitution $Si^{4+} \rightarrow Al^{3+}$ + 1/nM / SUP n+/ in the glass becomes less exothermic, the enthalpy of vitrification increases, and the tendency toward glassglass immiscibility becomes more pronounced. These parameters correlate smoothly with the ionic potential, z/r, of the substituting cation.

7535 **Electrochemical deposition of conducting ruthenium oxide films from solution.** Anderson, D.P.; Warren, L.F. (Rockwell International Science Center, Thousand Oaks, California). *Journal of the Electrochemical Society;* **131**: No. 2, 347-349(Feb 1984).

In the last decade, ruthenium oxide, RuO /sub x/ ($x \leq 2$), has been used extensively as the active anode electrocatalyst constituent for Cl_2 and O_2 evolution reactions, in chlorate production, and in metal electrowinning from mixed chloride-sulfate solutions. More recently, this material has been incorporated in several light-induced water electrolysis schemes and apparently possesses the ability to inhibit CdS photocorrosion by acting as a hole scavenger. The numerous applications for this catalyst material certainly warrant further studies of its electrochemical properties on a variety of substrates, e.g., semiconductors. The lack of a simple technique for controlled deposition of ruthenium oxide onto conducting substrates prompted us to investigate an electrochemical approach to this problem. We describe here a new way to electrochemically deposit conducting films of hydrated ruthenium oxide from an aqueous solution of the benzeneruthenium (II)aqua complex. The films slowly dissolve in aqueous electrolytes upon potential cycling, yet appear to be catalytic with regards to water oxidation.

40 CHEMISTRY

4001 ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 6955, 6973, 6988, 7005, 7008, 7008, 7014, 7014, 7015, 7015, 7597, 7604, 7621, 7622, 8166

7536 **(BDX—613-3373) Automated ion chromatographic analysis of plating solutions.** Smith, R.E.; Annable, P.L. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Nov 1985. Contract AC04-76DP00613. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003128.

Ion chromatography is an analytical technique that is capable of rapid, multi-component analysis of a variety of samples. The method is based on chromatographic separation of the various components followed by detection using any of three available detectors. Three general types of columns are used: anion exchange, cation exchange, and nonpolar. Conductivity, electrochemical, and ultraviolet-visible (UV-Vis) detectors can be used with any of the columns. This provides the analyst with sufficient versatility to analyze the complex mixtures present in many plating baths. It is especially useful to employ automation to provide maximum efficiency in analysis time. The analyses required most frequently must be outlined so that the appropriate columns and detectors can be properly installed. This paper will describe the basic principles of ion chromatography and will list the columns and detectors required for analyzing different plating solutions so that the individual analysts can optimize thier systems. 15 refs., 5 figs., 2 tabs.

7537 **(CONF-831025—) Analytical spectroscopy. Analytical Chemistry Symposia Series, Volume 19.** Lyon, W.S. (ed.). (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 383p. NTIS, PC A17/MF A01; 1; GPO Dep. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

This book contains papers covering several fields in analytical chemistry including lasers, mass spectrometry, inductively coupled plasma, activation analysis and emission spectroscopy. Separate abstracting and indexing was done for 64 papers in this book.

7538 (CONF-831025—, pp 3-12) **Recent applications of lasers in analytical chemistry.** Lytle, F.E. (Purdue Univ., West Lafayette, IN). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

This review primarily will update two recent articles concerning the use of lasers in analytical fluorimetry. The discussion will focus on the use of instrumental techniques developed to improve the working detection limit via increases in selectivity. Examples will include chromatography, time resolution and line narrowing. In addition, the topic of multiphoton ionization/mass spectrometry will be covered. 18 refs., 1 tab.

7539 (CONF-831025—, pp 43-47) **Selective fluorometric determinations by laser-induced matrix isolation fluorescence spectrometry.** Wehry, E.L. (Univ. of Tennessee, Knoxville). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

The preparation of samples by matrix isolation for low-temperature spectrometric examination is described, and the specific

characteristics of matrix isolation molecular luminescence spectra are considered. The advantages of laser excitation of matrix isolation fluorescence are outlined, and applications of the technique to characterization of complex samples are surveyed. 22 refs.

7540 (CONF-831025—, pp 49-55) **Metal surface enhanced fluorescence.** Harris, T.D.; Glass, A.M.; Olson, D.H. (Bell Labs., Murray Hill, NJ). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

The report in 1977 by Jeanmarie and Van Duyne of greatly enhanced Raman scattering from silver electrodes triggered a worldwide flurry of activity in surface perturbations of spectroscopy. This activity has centered on the nature and application of the phenomenon for Raman scattering. However, it has become increasingly clear that the origin of the high intensity is a simple electrodynamic effect due to the peculiar spectroscopy of small metal particles. It has also become clear that other forms of spectroscopy (absorption, emission, photochemistry, etc.) will be similarly affected. Several recent reports have demonstrated the large perturbation of the apparent quantum yield and the relaxation rate for fluorophore near both smooth metal surfaces and arrays of small metal particles. The proven and potential applications of these dramatic changes in fluorescence parameters are discussed. The preparation of appropriate substrates is described. The generality of this phenomenon and the consequences of surface chemistry is outlined. Finally the application of these substrates for reduction of quenching interference in fluorometric analysis is demonstrated. 9 refs., 2 figs., 1 tab.

7541 (CONF-831025—, pp 63-68) **Performance appraisal studies of laser-enhanced ionization in flames - the determination of nickel in petroleum products.** Turk, G.C.; Harvilla, G.J.; Webb, J.D.; Forster, A.R. (National Bureau of Standards, Washington, DC; Shell Development Co., Houston, TX; The Standard Oil Co., Cleveland, OH). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Laser-enhanced ionization (LEI) in flames is an ultrasensitive atomic flame spectrometric technique based on the efficient thermal ionization of atomic species which have been selectively excited by tunable laser radiation. The performance of LEI for real sample analysis is presently being evaluated. A successful determination of trace Ni concentrations in heavy oil flash distillate and Standard Reference Material Fuel Oil has been performed. One gram samples were diluted into 100 to 700 mL volumes of a xylene/n-butanol solvent mixture and aspirated directly into an air-acetylene flame. Stepwise laser excitation of Ni was performed using a Nd:YAG pumped dual-dye laser system. Accurate and reproducible results were obtained. 17 refs., 1 fig., 1 tab.

7542 (CONF-831025—, pp 89-101) **Some advances in inorganic analytical mass spectrometry.** Svec, H.J. (Ames Lab., IA). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Three recent developments in mass spectrometry are applicable to analytical problems. High powered laser excitation of metals, semi-conductors, and insulators combined with mass analysis provides an absolute analytical probe. Combining an inductively coupled argon plasma with mass analysis provides facile and sensitive analysis of aqueous solutions. A cryogenic hollow cathode containing ice is a proven ion source for 20 to 50 μL of aqueous samples with prior treatment. 21 refs., 12 figs., 3 tabs.

7543 (CONF-831025—, pp 111-118) **Americium determination using an isotope dilution mass spectrometry technique.** Crawford, D.W.; Peavy, R.D. (Department of Energy, Argonne, IL). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Americium-241, produced by the B-decay of plutonium-241, represents a significant impurity in plutonium materials, affecting the nuclear properties of the material, as well as measurements such as those for nuclear materials accountability. An isotope dilution mass spectrometry method offers some potential advantages over the current methods for the determination of americium including radiochemistry, nondestructive analysis, and wet chemical techniques. 3 refs., 7 tabs.

7544 (CONF-831025—, pp 133-136) **Improved precision and speed of thermal ionisation mass spectrometry with a multicollector.** Turner, P.J.; Cantle, J.E.; Haines, R.C. (VG Isotopes Ltd., Winsford, England). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

The analytical accuracy of uranium analysis is limited by fractionation occuring before and during the data acquisition period. With peak jumping methods, increasing the data measuring period beyond 15 to 20 minutes can result in a deteriorating, internal precision because the ratio being measured is changing significantly. In addition the operator often has the choice of taking poor data when the beam is unstable or decaying rapidly or waiting for beam stability and measuring a more fractionated ratio to higher precision. Either way measurement accuracy is reduced. Simultaneous measurement of the ion beams using a multicollector greatly eases these difficulties. Multicollector analysis offers the following advantages for uranium analysis: (1) greatly reduced analysis time; (2) improved internal errors duing data acquisition allowing: (a) smaller samples to be measured, (b) greater dynamic ratios to be measured before internal errors become comparable to the external errors; (3) short data acquisition time giving better results on rapidly fractionating samples; (4) great tolerance to unstable and rapidly decaying beams resulting in fewer "unsatisfactory" analyses. 4 figs.

7545 (CONF-831025—, pp 137-142) **Resonance ionization mass spectrometry of iron - quantitative aspects.** Fassett, J.D.; Moore, L.J.; Travis, J.C. (National Bureau of Standards, Washington, DC). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Resonance ionization mass spectrometry has been used to study the formation of ions of iron. Iron was thermally vaporized from a filament at 1250 K. A one-wavelength, two-photon ionization scheme was employed which utilized the tunable uv light provided by a Nd:YAG pumped dye laser with frequency doubling. The systematics of the resonance ionization process has been studied and compared with thermal ionization. 7 refs., 1 tab.

7546 (CONF-831025—, pp 149-154) **Sputter initiated resonance ionization spectroscopy for trace element analysis.** Parks, J.E.; Schmitt, H.W.; Hurst, G.S.; Fairbank, W.M. Jr. (Atom Sciences, Inc., Oak Ridge, TN; Oak Ridge National Lab., TN; Colorado State Univ., Ft. Collins). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

This paper describes a new technique, Sputter-Initiated Resonance Ionization Spectroscopy (SIRIS), a technique being developed commercially by Atom Sciences, Inc., for ultrasensitive elemental analysis solid samples. SIRIS combines resonance ionization spectroscopy and ion beam sputtering to provide analyses for all the elements except helium and neon with predicted sensitivities down to 1 part in 10^{12} in routine analysis, and greater for special cases. Recent results in the development of the new SIRIS process and apparatus are presented. 3 refs., 8 figs.

7547 (CONF-831025—, pp 161-165) **Determination of uranium in urine by isotope dilution mass spectrometry using resin bead loading.** May, M.P.; Walker, R.L.; Scott, T.G.; Dyer, F.F.; Stokely, J.R. (Oak Ridge National Lab., TN). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Ion exchange separations are coupled with isotope dilution mass spectrometry to provide a highly sensitive method for the determination of uranium in urine. This method was examined for its

sensitivity, practicality, reproducibility, and accuracy. Our goal, as suggested by the Nuclear Regulatory Commission, was to measure uranium at the 0.1 ng/ml +- 0.01 ng/ml level for 10 mL aliquots of urine. The ability to measure this low concentration of uranium can be limited by both instrumental background and contamination from working environment, reagents, and labware in the procedure (i.e., procedural blank). Initially, high blank levels of uranium were observed so much emphasis was placed upon lowering the procedural blank. To achieve a 10% uncertainty, this blank must remain low and be reproducible throughout all determinations. The validity of the method was tested by analyzing an artificial urine spiked with a known concentration of uranium and several human urine samples analyzed by an independent method. Details and results of the method plus its possible bioassay applications are presented. 1 tab.

7548 (CONF-831025—, pp 173-177) **Laser enhanced ionization in glow discharge mass spectrometry.** Harrison, W.W.; Savickas, P.J.; Marcus, R.K.; Hess, K.R. (Univ. of Virginia, Charlottesville). 1984. NTIS, PC A17/MF A01. File Number DE85014573. Contract AS05-80ER10635.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

The output of a tunable dye laser was used to ionize selectively the atomic population produced in a glow discharge. Potassium was atomized by both a Knudsen cell and the glow discharge for comparison. Wavelength ionization spectra and mass spectra showed the ionization created by the laser radiation. 11 refs., 3 figs.

7549 (CONF-831025—, pp 201-202) **Determination of trace impurities in uranium matrices by inductively coupled plasma-atomic emission spectrometry.** Halouma, A.A.; Farrar, R.B.; Hester, E.A.; Morrow, R.W. (Oak Ridge Gaseous Diffusion Plant, TN). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES) with its wide acceptance as a versatile technique for the determination of trace elements lends itself as a possible alternative. Our objective is to establish conditions for an ICP-AES analysis procedure that can replace several of the currently used techniques, thus achieving a faster analysis time and a reduction in analysis cost. Our proposed procedure entails the removal of the uranium from its solutions through a liquid-liquid extraction with Tri-(2-Ethyl-Hexyl)-Phosphate (TEHP)-Hexane mixture. The impurity elements are then determined using an ICP Spectrometer. A detailed study was conducted to establish the optimum conditions for uranium extraction with TEHP. The study revealed that one to five grams of uranium would be removed from a 50 ml solution containing 10% nitric acid when extracted twice with 50 ml of equal molecular volume of TEHP and Hexane (3:1 volume to volume).

7550 (CONF-831025—, pp 203-211) **Measurement of rhodium and palladium in selected Hanford defense wastes.** West, M.H.; Homi, C.S.; Hunter, C.H. (Rockwell Hanford Operations, Richland, WA). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Numerous radioactive, defense waste types have been generated by different fuel reprocessing plants at Hanford, Washington. These wastes have been systematically combined and concentrated using vacuum evaporators, thus significantly increasing the complexity of the wastes. High concentrations of hydroxide, aluminum species, and organic complexants (EDTA, HEDTA, citrate, etc.) currently exist in the double-shell slurry waste type. Approximately 1000 kilograms of rhodium and 790 kilograms of palladium exist within the available wastes. In order to test the applicability of the highly alkaline double-shell slurry as a potential feed stock for rhodium and palladium recovery processes, analytical methodology has been developed for precious metal analyses. 10 refs., 4 figs., 3 tabs.

7551 (CONF-831025—, pp 219-225) **Evolution of containment facilities for spectroscopic analysis at Rockwell Hanford Operations.** Hiller, J.M. (Rockwell Hanford Operations, Richland, WA). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

The analysis of radioactive material requires much thought concerning getting the job done while still maintaining a safe working environment. At Rockwell Hanford Operations, we have gone through several stages of evolution in instrumentation for spectroscopic elemental analysis, reflecting different philosophies with respect to shielding and contamination control. Atomic absorption and inductively coupled plasma emission spectroscopic systems have been used for analyzing samples in support of a fission product recovery plant, nuclear waste processing and characterization programs, and U and Pu separation plants. Design thoughts, criticisms, and lessons learned in 20 years of containment for spectroscopic analysis are presented. 3 refs., 6 figs., 2 tabs.

7552 (CONF-831025—, pp 263-272) **Analytical Research at the Institute of Radiochemistry, Nuclear Research Center Karlsruhe, FRG.** Gantner, E.; Mainka, E.; Ruf, H.; Ache, H.J. (Kernforschungszentrum Karlsruhe, Germany). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

A review will be presented of the various analytical techniques applied to the solution of chemical problems within the ongoing research in energy technology at the Institute of Radiochemistry, Nuclear Research Center Karlsruhe, FRG. Three typical applications, neutron monitoring of solutions of fissile materials polarographic and voltammetric methods for the determination traces of Pt, Tc and Re, and ICP-spectroscopy of uranium solutions will be discussed. 11 figs.

7553 (CONF-831025—, pp 273-284) **Comparison of burnup methods for $(Th,U)O_2$ fuel.** Green, L.W.; Cassidy, R.M.; Edwards, W.J.; Knight, C.H. (Chalk River Nuclear Labs., Ontario). 1984. NTIS, PC A17/MF A01. File Number DE85014573. (CONF-831025—). Contract AC06-76RL01830.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Analysis methods based on thermal ionisation mass spectrometry (TIMS), high performance liquid chromatography (HPLC) and instrumental neutron activation (INA) were investigated. Fission products ^{139}La, ^{140}Ce, ^{143}Ce, $^{148+146}Nd$ and the sum of the major lanthanides (masses 139 to 152) were evaluated as fission monitors. A TIMS-$^{148+146}Nd$ method was selected as a reference method, and a HPLC-^{139}La method showed good agreement and similar precision. Results obtained by INA-^{143}Ce, HPLC-(139-152) and TIMS-^{148}Nd methods showed significant differences from those obtained by the above two, for various reasons. The weight and initial composition of the fuel was shown to give a sufficiently accurate estimate of the initial heavy element content; this combined with the HPLC-^{139}La method yielded a fast, low-cost burnup method. 12 refs., 3 figs., 2 tabs.

7554 (CONF-831025—, pp 285-292) **Monitoring of radionuclides and metallic impurities in the KNK-II priamry sodium.** Stamm, H.H.; Stade, K.Ch. (Kernforschungszentrum Karlsruhe, Germany; Kernkraftwerk-Betriebsgesellschaft m.b.H., Eggenstein-Leopoldshafen, Germany). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

The first German experimental LMFBR, KNK-II at the Karlsruhe Nuclear Research Center, is regularly monitored for impurities in its primary sodium system. Representative sampling from the liquid alkali metal is an even more critical step than from many other solvent systems. Radionuclides in KNK primary sodium are determined by gamma spectrometry. After decay of ^{24}Na, the main activities are due to ^{22}Na, ^{54}Mn, ^{65}Zn and /sup 110m/Ag. Fission products (^{137}Cs, ^{134}Cs and ^{131}I) have been detectable only after fuel element failures. Fe, Cr, Ni, Mn, Co, Cu, Pb and Zn in sodium are

determined by flameless atomic absorption spectroscopy. Detection efficienies achieved are 2 to 10 ng metal/g Na. 5 refs., 1 fig., 7 tabs.

7555 (CONF-831025—, pp 293-298) **Surface characterization of leadscrews taken from the TMI-2 reactor vessel.** Hofstetter, K.J.; Lowenschuss, H.; Baston, V.F. (GPU Nuclear Corp., Middletown, PA; Eidgenoessisches Institut fur Reaktorforschung, Wurenlingen, Switzerland; Physical Sciences Inc., Idaho Falls, Idaho). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Analyses of leadscrews have revealed a 25 to 40 μm tightly adhered surface layer containing ^{137}Cs and ^{134}Cs (up to 1000 μCi/cm²). A second more loosely bound layer (70 to 90 μm) is also present containing principally core debris. Dissolution tests show ~90% of the radiocesium is associated with the tightly adhered layer. Surface analyses (SEM, microprobe and Auger spectrometry) and macroanalyses (emission spectrometry, XRF and XRD) confirm the presence of corrosion materials and core debris on the surface. 3 refs., 3 figs., 1 tab.

7556 (CONF-831025—, pp 299-307) **n-type high-purity germanium detector-based on-line rapid coal analysis system.** LeVert, F.E.; Managan, W.W. (Technology for Energy Corp., Knoxville, TN). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

This paper describes an n-type high-purity germanium (HPGe) detector-based coal analysis system that is capable of providing a real-time (200-second update time) analysis of sulfur and other elemental constituents of coal. The analysis system consists of a 234-μg californium-252 neutron source with suitable moderation and shielding, state-of-the-art pulse-shaping and processing electronics coupled to a 23.4% n-type HPGe detector, a 7000-series EG & G ORTEC multichannel analyzer, and a PDP/11 computer. This system is capable of processing very high input pulse rates with low dead time. System input rates of 75 kHz to a gated amplifier were processed with a live-to-real-time ratio of greater than 0.55 for the pulses in the range of interest of this measurement (i.e., from 2 MeV to 10 MeV). Results are also presented which compare the measured and predicted throughput pulse rates for different spectroscopy systems. 7 refs., 3 figs., 1 tab.

7557 (CONF-831025—, pp 313-319) **Environmental applications for an intrinsic germanium well detector.** Stegnar, P.; Eldridge, J.S.; Teasley, N.A.; Oakes, T.W. (Oak Ridge National Lab., TN). 1984. NTIS, PC A17/MF A01. File Number DE85014573. Contract W-7405-ENG-26.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

The overall performance of an intrinsic germanium well detector for ^{129}I measurements was investigated in a program of environmental surveillance. Concentrations of ^{129}I and ^{131}I were determined in thyroids of road-killed deer showing the highest activities of ^{129}I in the animals from the near vicinity of Oak Ridge National Laboratory. This demonstrates the utility of road-killed deer as a bionindicator for radioiodine around nuclear facilities. 6 refs., 2 figs., 3 tabs.

7558 (CONF-831025—, pp 333-335) **Spectroscopic diagnostics of an argon plasma jet seeded with uranium.** Anderson, G.K. (Los Alamos National Lab., NM). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

An 80-kW vortex-stabilized plasma torch is used to produce uranium vapor from submicron uranium powder. The torch operates at near atmospheric pressure with a mixture of argon and helium in the ratio of 4:1, at a flow rate of ~0.1 moles/s. The uranium powder (at flow rates up to 0.4 g/s) is entrained in the Ar:He mixture. This differs from the "normal" mode of injection for powder processing, in which the powder is fed into the arc jet downstream of the arc itself. The hot gases leaving the torch expand into a vacuum chamber, forming a supersonic free jet. The arc jet rapidly cools the gases, but also lowers the number density, so that condensation of the (now supersaturated) metal vapor is prevented. A variety of spectroscopic methods have been used to characterize the plasma torch and the arc jet. Observation of Stark-broadened atomic emission from the torch allows a measurement of both temperature and degree of ionization of the arc gas. Visible emission spectra of the arc jet reveal which chemical species are present. Quantitative determinations of species concentrations in the jet are made by means of absorption spectra. The presence of incompletely vaporized metal powder in the jet is revealed by laser light scattering, and the particle velocities are measured by laser Doppler velocimetry (LDV). The results of these measurements will be discussed in the following paragraphs.

7559 (CONF-831025—, pp 355-356) **Analysis of molecular hydrogen using spontaneous Raman spectroscopy.** Veirs, K.; Rosenblatt, G.M. (Los Alamos National Lab., NM). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Relative number densities of all molecular isotopic species of hydrogen (H_2, HD, HT, D_2, DT, T_2) are determined by Raman spectroscopy. Unambiguous identification is due to the unique Raman shift of each species. Modern laser methods lower the detection limit to 6 ppM in atmospheric samples.

7560 (CONF-831025—, pp 357-358) **Diffuse reflectance infrared Fourier transform spectroscopy: a versatile and promising analytical technique for solids.** Smyrl, N.R.; Fuller, E.L. Jr.; Powell, G.L. (Union Carbide Corp., Oak Ridge, TN). 1984. NTIS, PC A17/MF A01. File Number DE85014573. Contract W-7405-ENG-26.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Diffuse reflectance (DR) is a solid sampling technique which has seen a resurgence of activity in the past several years, particularly in the infrared spectral region. This resurgence is due in large part to the widespread use of Fourier transform infrared spectrometers which with their very high optical throughput and signal averaging capabilities require only very simple, less efficient optical accessories for collection of the diffusely reflected radiation. We have applied the diffuse reflectance infrared Fourier transform (DRIFT) technique to a variety of organic and inorganic solids both as powders and in the bulk forms in an effort to obtain molecular information that is often difficult to obtain by other means. 2 refs.

7561 (CONF-831025—, pp 371-372) **Applications of Fourier self-deconvolution.** Howell, R.L. (Union Carbide Corp., Oak Ridge, TN). 1984. NTIS, PC A17/MF A01. File Number DE85014573. Contract W-7405-ENG-26.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Fourier self-deconvolution can be a powerful tool when used to obtain peak parameter data on bands comprising contours and shoulders. These are often not easily discernable even to experienced spectroscopists. This information may be optimized by a band fitting program to yield the positions, widths, and heights of the component bands. 9 refs.

7562 (CONF-831025—, pp 373-374) **Capillary supercritical fluid chromatography - Fourier transform infrared spectrometry.** Olesik, S.V.; French, S.B.; Movotny, M. (Indiana Univ., Bloomington). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

One of the most demanding tasks asked of an analytical chemist today is to separate and identify the components of a nonvolatile complex mixture. An efficient separation technique combined with a universal detector that provides structural information, therefore, would be a great asset to analytical chemists. Capillary supercritical fluid chromatography (SFC) - Fourier transform infrared spectrometry (FTIR) shows great potential for being such a technique. SFC-FTIR shows great potential as a very powerful technique for separation and identification of thermally labile and

nonvolatile compounds. Research is continuing in these labs to further optimize the technique. 2 refs.

7563 **(DOE/OT/21400—T4) Preparation of 97.683 wt % U^{235} uranium isotopic standard.** Petit, G.S.; Smitherman, O.C. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 12 Jul 1965. Contract AC05-84OT21400. 7p. (K-L—2052). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003601.

A very highly enriched (VHE) uranium isotopic standard has been prepared as the urano-uranic oxide. The enrichment level of the standard, determined at the Oak Ridge Gaseous Diffusion Plant, is 97.683 +-0.015 weight percent ^{235}U, the precision expressed at the 95% confidence limits. This standard was prepared from 2100 g of uranium hexafluoride removed from a cylinder containing 21 kg of uranium hexafluoride withdrawn from the Portsmouth cascade. It was received in the Oak Ridge Gaseous Diffusion Plant Laboratory on March 10, 1964. The purification of this material was conducted during March 1965.

7564 **(DOE/OT/21400—T10) Quantitative analysis of UO_2-U_3O_8 mixtures by x-ray diffraction.** Bensey, F.N.; Eckert, A.C. (Carbide and Carbon Chemicals Corp., Oak Ridge, TN (USA)). 8 Mar 1949. Contract AC05-84OT21400. 12p. (K—366). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003594.

A method of quantitative analysis using x-ray diffraction has been applied to the determination of UO_2 in UO_2-U_3O_8 mixtures coneaining 1% to 30% UO_2 by weight. Two techniques have been employed in the analysis. In one the pattern is recorded photographically, and in the other the diffracted x-rays are measured by a Geiger counter spectrometer. The photographic method is good to a lower concentration limit of 2%, and the Geiger counter spectrometer has a lower limit of 1%. 5 refs., 4 figs., 1 tab.

7565 **(DP-MS—85-66) Aluminum, boron, and mercury measurement via ion-exchange direct current argon plasma (DCAP) spectrometry.** Maxwell, S.L. III. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 7p. (CONF-8510151—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003147.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

The accurate measurement of aluminum, boron, and mercury in process dissolver solutions at the Savannah River Plant (SRP) is important. Costs for the processing of non-SRP uranium fuels are based in part on the measured aluminum content of the fuel. Boron is a nuclear safety control in some dissolutions and mercury(II) is a catalyst in the dissolution of uranium-plutonium oxide fuels. In analyses, ion exchange is used for selective separations and for removing high activity constituents in dissolver solutions prior to measurement via direct current argon plasma (DCAP) spectrometry. Aluminum is separated via anion exchange using oxalate-hydrochloric acid mixtures, boron is separated via cation exchange using 0.05 M nitric acid, and mercury(II) is separated via cation exchange using 40% ethanol-0.2 M hydrochloric acid. The aluminum content is measured with a precision of better than +-1.0% (RSD) using gravimetric dilutions and sample measurements bracketted by standard measurements. Boron and mercury are measured with a precision of better than +-3.0% (RSD) using volumetric dilutions. 4 refs., 4 tabs.

7566 **(K-TL—107) Radiation monitoring of alumina for determination of uranium content.** Bailey, J.C. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1 Jun 1970. Contract AC05-84OT21400. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003590.

Activated alumina is used as the trap charge in processing operations to absorb UF_6 from vent gases. This study was made to determine whether a standard xenon probe (xenon-filled ionization chamber) and a Samson survey meter could be used to monitor the gamma rdiation emitted by uranium contained in the leached alumina, and if, on the basis of these measurements, a useful estimate could be made of the amount of ^{235}U contained in the alumina. Results indicate that the radiation monitoring will provide a simple and reliable means for establishing reasonable upper limits for the quantities of contained ^{235}U in leached waste alumina.

7567 **(NUREG/CR—0602) Active nondestructive assay of nuclear materials: principles and applications.** Gozani, Tsahi. (Science Applications, Inc., Palo Alto, CA (USA); Monsanto Research Corp., Miamisburg, OH (USA). Mound). Jan 1981. Contract AC04-76DP00053. 409p. (SAI-MLM—2585). NTIS, PC A18/MF A01 - GPO $10.00. File Number TI86000896.

The purpose of this book is to present, coherently and comprehensively, the wealth of available but scattered information on the principles and applications of active nondestructive analysis (ANDA). Chapters are devoted to the following: background and overview; interactions of neutrons with matter; interactions of γ-rays with matter; neutron production and sources; γ-ray production and sources; effects of neutron and γ-ray transport in bulk media; signatures of neutron- and photon-induced fissions; neutron and photon detection systems and electronics; representative ANDA systems; and instrument analysis, calibration, and measurement control for ANDA. Each chapter has an introductory section describing the relationship of the topic of that chapter to ANDA. Each chapter ends with a section that summarizes the main results and conclusions of the chapter, and a reference list.

7568 **Determination of Si/Al ratios in zeolites by proton inelastic scattering.** Hanson, A.L.; Jones, K.W.; Corbin, D.R. (Brookhaven National Lab., Upton, NY, USA; Du Pont de Nemours, E.I. and Co., Wilmington, DE (USA). Central Research Dept.). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **9**: No. 3, 301-305(Jun 1985).

Proton inelastic scattering has been used to determine the bulk ratio of silicon to aluminum in twelve zeolites. This nuclear reaction analytical technique is nondestructive and provides reliable information in short analysis times for light elements at low concentrations. The 844- and 1014-keV states of aluminum and the 1779-keV state of silicon were excited with 3.4-MeV protons, and the resulting gamma rays were counted with a Ge(Li) detector. The results are compared to those obtained from a larger round-robin series of eight separate analyses using six different analytical techniques. The average deviation of the results from the mean values for each sample in the round-robin series is 3.0%. Only two of the analyses fell outside one standard deviation from the adjusted mean, and both of these are within two standard deviations.

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REFER ALSO TO CITATION(S) 7444, 7460, 7545

7569 (CONF-831025—, pp 179-185) **Examination of excited state populations in sputtering using multiphoton resonance ionization.** Kimock, F.M.; Baxter, J.P.; Pappas, D.L.; Kobrin, P.H.; Winograd, N. (Pennsylvania State Univ., University Park). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Multiphoton Resonance Ionization has been employed to study the populations of excited state atoms ejected from ion bombarded metal surfaces. Preliminary investigations have focused on three model systems: aluminum, indium and cobalt. In this paper we examine the effect of primary ion energy (2 to 12 keV Ar^+) on excited state yields for these three systems. The influence of the sample matrix on excited state populations of sputtered atoms is also discussed. 8 refs., 4 figs.

7570 **(DOE/ER/04987—6) Solid state, surface and catalytic properties of oxides. Progress report, October 1984-September 1985.** Kung, H.H. (Northwestern Univ., Evanston, IL (USA). Dept. of Chemical Engineering). 1985. Contract AC02-78ER04987. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003516.

This report contains 3 separate reports of progress on the following projects: surface chemistry of ZnO single crystal surfaces, selective oxidation of hydrocarbons, and effect of hydroxylation on the interaction of hydrocarbons on iron oxide. Separate abstracts and indexing was prepared for the 3 papers in this report. A list of publications resulting from this project is included at the back of the report. (PLG)

7571 (DOE/ER/04987—6, pp 15, Paper 1) **Surface chemistry of ZnO single crystal surfaces.** 1985. NTIS, PC A03/MF A01. File Number DE86003516. Contract AC02-78ER04987.

In Solid state, surface and catalytic properties of oxides. Progress report, October 1984-September 1985.

Different single crystal surfaces of ZnO have different atomic structures. Associated with this are the different magnitudes of surface dipoles, different degrees of steric hindrance experienced by molecules approaching the surface Zn anions, and different electron densities (or hardness) for the surface Zn ions. These should result in different chemical and catalytic properties for different crystal planes. The objective of this project is to explore and attempt to understand these different chemical and catalytic properties. 4 refs., 3 figs., 3 tabs.

7572 (DOE/ER/04987—6, pp 7, Paper 3) **Effect of hydroxylation on the interaction of hydrocarbons on iron oxide.** 1985. NTIS, PC A03/MF A01. File Number DE86003516. Contract AC02-78ER04987.

In Solid state, surface and catalytic properties of oxides. Progress report, October 1984-September 1985.

The properties of an iron oxide surface (in fact, for oxides in general) depend on the concentration of surface hydroxyl groups. This has been demonstrated for the adsorption of compounds such as CO, NO, and ammonia. However, there are little systematic studies on the effect of surface hydroxyls on the reaction of hydrocarbons on surfaces. The objective of this project is to systematically investigate this effect. 10 refs.

7573 **(DOE/ER/10829—6) Selectivity, activity and metal-support interactions of Group VIII bimetallic catalysts. Progress report, 15 August 1984-15 October 1985.** Haller, G.L. (Yale Univ., New Haven, CT (USA). Dept. of Chemical Engineering). Oct 1985. Contract AC02-81ER10829. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003857.

In this report, we outline progress during the last year on our program to investigate bimetallic interaction in the systems Rh-Pt and Ru-Cu. In both cases, we are primarily interested in the effect of support on the nature and degree of interaction. For Rh-Pt, the interacting support is TiO_2 and the reaction used to probe the interaction is CO hydrogenation. As we had previously deduced from the investigation of hydrogenolysis, the relative activity of the Rh-Pt/TiO_2 series for CO hydrogenation is consistent with there being Rh enrichment on the small bimetallic clusters. For the Ru-Cu bimetallic system the support of interest is SiO_2. The degree of interaction between the metals depends on the kind of SiO_2 used. Hydrogen chemisorption, cyclohexane hydrogenolysis and dehydrogenation were used as the catalytic probes of support effects on metal-metal interaction. As a part of our continuing investigation of support influence on bimetallic interaction, the metal-oxide interaction of Rh/TiO_2 and Rh/V_2O_3 have been compared. While the gross features of and effects on this interaction are the same, the mechanism is apparently different. 23 refs., 1 tab.

7574 **(DOE/ER/10830—4) Model catalyst studies of SMSI and the role of D-electrons in chemisorption and catalysis. Progress report, January 15, 1985-January 14, 1986.** Henrich, V.E. (Yale Univ., New Haven, CT (USA). Dept. of Applied Physics). Oct 1985. Contract AC02-81ER10830. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003150.

Electron spectroscopic studies of the surface composition, electronic structure and chemisorption properties of model Rh/TiO_2 catalysts fabricated on well characterized single-crystal supports have provided evidence that argues strongly against the simple charge transfer model of strong metal-support interaction that involves the transfer of electrons from surface Ti^{3+} ions that are created by high temperature reduction. The presence of surface Ti^{3+} ions does appear to be necessary in order to facilitate the migration of sub-oxides over the catalyst particles in the SMSI state, but hydrogen is not necessary if Ti^{3+} defect sites exist prior to high temperature annealing. A newly constructed electron beam evaporation source is now being used for in situ deposition of Rh onto TiO_2 supports, giving greater control over catalyst loading and particle size. TEM studies of catalyst morphology, performed in parallel with the electron spectroscopic studies, are continuing. 3 figs.

7575 **(DOE/OT/21400—T12) Phase equilibria of the ternary system: uranium hexafluoride-chlorine trifluoride-hydrogen fluoride. Part V. Liquid-vapor equilibria of the binary system: chlorine trifluoride-hydrogen fluoride.** McGill, R.M.; Barber, E.J. (Carbide and Carbon Chemicals Corp., Oak Ridge, TN (USA)). 26 Feb 1954. Contract AC05-84OT21400. 22p. (K—1103). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003585.

Declassified 24 Feb 1972.

The liquid-vapor equilibrium of the binary system chlorine trifluoride-hydrogen fluoride has been investigated at total pressures of 1.5, 2.0, 2.5, 3.0, and 4.0 atmospheres absolute by means of a nickel Othmer-type equilibrium still. The system is azeotropic at all these pressures, the minimum boiling azeotrope mixture containing about 67 formula per cent chlorine trifluoride. The possibility that the azeotrope is a molecular compound is considered. Activity coefficients for the components in solution are calculated from the equilibria data. 11 refs., 6 figs., 3 tabs.

7576 **Studies of chemical reactivity in the condensed phase. I. The dynamics of iodine photodissociation and recombination on a picosecond time scale and comparison to theories for chemical reactions in solution.** Harris, A.L.; Berg, M.; Harris, C.B. (Department of Chemistry, University of California, Berkeley, California 94720 and the Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **84**: No. 2, 788-806(15 Jan 1986).

Picosecond transient absorption measurements from 1000—295 nm are used to monitor the recombination dynamics of iodine after photodissociation in a variety of inert solvents. The high time resolution and signal-to-noise ratio of these measurements permits the development of a detailed model of this reaction, which should resolve disagreements over the time scales of geminate recombination and vibrational relaxation and over the role of excited electronic state trapping. Most of the atoms which undergo geminate recombination do so in $<$ or $=15$ ps, in agreement with the predictions of existing molecular dynamics simulations. The subsequent vibrational and electronic energy relaxation of the recombined molecule is relatively slow and accounts for most of the transient absorption dynamics. The relaxing X-state vibrational population distribution is extracted with an approximate method using calculated spectra of the excited vibrational levels and is compared to recent models. Vibrational relaxation times vary from $\sim$15 ps near the middle of the ground state well to $\sim$150 ps for complete relaxation to $v = 0$. The vibrational relaxation rates do not provide support for the predicted role of resonant vibration-to-vibration energy transfer to chlorinated methane solvents, but some evidence for this mechanism is found in alkane solvents. B-state predissociation times of 10—15 ps and A′-state lifetimes of 65—2700 ps are found depending on the solvent. Current theory is not able to satisfactorily explain the large variation of the A′-state lifetime in various solvents.

7577 **More on the multidimensional surface intersection problem and classical trajectory surface hopping.** Stine, J.R.; Muckerman, J.T. (M-1, C920, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **84**: No. 2, 1056-1057(15 Jan 1986). Contract AC02-76CH00016.

We respond to the previous Comment by Mead and Truhlar pointing out a circularity in our published analysis of a trajectory passing through a locally avoided intersection of potential energy surfaces in a two state system. We did not distinguish clearly in that analysis between properties of the physical system and those of

our model for it. Our "reduction" to a one-dimensional problem is rather a "mapping" onto a one-dimensional model. We present a clearer description of the actual procedures we used to demonstrate that our method is valid for the types of systems to which we have applied it.

7578 **Photoionization mass spectrometric study and ab initio calculations of ionization and bonding in P—H compounds; heats of formation, bond energies, and the $^3B_1$—$^1A_1$ separation in PH^+_2.** Berkowitz, J.; Curtiss, L.A.; Gibson, S.T.; Greene, J.P.; Hillhouse, G.L.; Pople, J.A. (Physics Division, Argonne National Laboratory, Argonne, Illinois). *Journal of Chemical Physics;* **84**: No. 1, 375-384(1 Jan 1986). Contract W-31-109-ENG-38.

The ion yield curves of PH^+_3, PH^+_2, and PH^+ from photoionization of PH_3 have been measured. The free radical PH_2 has been generated by pyrolysis, and the ion yield curve of PH^+_2 (PH_2) determined. These measurements yield directly I.P. (PH_3) = 9.870 +- 0.002 eV, and I.P. (PH_2) = 9.824 +- 0.002 eV. In addition, we deduce D_0 (H_2P—H) = 82.46 +- 0.46 kcal/mol, D_0 (HP—H) = 74.2 +- 2 kcal/mol, D_0 (P—H) = 70.5 +- 2 kcal/mol, I.P. (PH) = 10.18 +- 0.1 eV, and other thermochemically related quantities. The ionization energies of PH, PH_2, and PH_3 are computed by ab initio molecular orbital methods to fourth order in Moller—Plesset theory, and are found to be in good agreement with experiment. The ground state of PH^+_2 is inferred to be $^1A_1$, with the $^3B_1$ state higher by > or =0.71 eV. This ordering is the reverse of that in CH_2 and NH^+_2.

7579 **Multiproperty empirical potential energy surface for the reaction $H+Br_2 \rightarrow HBr+Br$.** Blais, N.C.; Truhlar, D.G. (Chemistry Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **83**: No. 11, 5546-5558(1 Dec 1985).

We have made systematic variations in our previously reported potential energy surface for the reaction $H+Br_2$, and we have tested the new potential energy surfaces by extensive trajectory calculations. We have attempted to find a surface that simultaneously displays as many as possible of the attributes of this reaction in agreement with experiment and that has a bent transition state with a weak bending force constant for consistency with recent ab initio calculations. The best surfaces overall, called surfaces 18M and 19M, are in reasonable agreement with experiment for the angular scattering distribution, the reaction cross section as a function of translational energy, the average vibrational and rotational energies of the product HBr, and the thermal rate constant at room temperature. They are less accurate for the deuterium isotope effect and the breadth of the product vibrational distribution at room temperature, and for the average product translation energy at high collision energy.

7580 **Theory of relaxation processes in metastable systems.** Blackwell, M.F. (Laboratory of Chemical Biodynamics, Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **83**: No. 11, 5589-5594(1 Dec 1985).

This paper presents a theory of relaxation for systems of spins that are metastable as a result of unimolecular spin decay. A complex Hamiltonian is used to describe the spin decay. Redfield's theory [Adv. Magn. Reson. 1, 1 (1965)] which describes relaxation in stable spin systems, is treated as the interaction representation of the theory for metastable systems. The resulting rate equations are valid for systems in which spin relaxation is much more efficient than spin decay. An examination of the equations for the case of triplet state photokinetics reveals that the spin relaxation rate matrix is time dependent. A simple solution is offered which yields a new mechanism of spin polarization in metastable systems.

7581 **Coupled states distorted wave study of the $O(^3P)+H_2$ (D_2, HD, DH) reaction.** Schatz, G.C. (Theoretical Chemistry Group, Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **83**: No. 11, 5677-5686(1 Dec 1985).

In this paper, the coupled states distorted wave (CSDW) method is used to study the quantum reactive collision dynamics of $O(^3P)+H_2 \rightarrow OH+H$ and its D_2, HD, and DH counterparts. The potential surface used is the sum of a LEPS potential (due to Johnson and Winter) and a correction factor which raises the barrier for $H+OH \rightarrow HO+H$ exchange to a realistic value. Full basis set convergence of the CSDW transition probabilities is established at low energies where tunneling dominates the dynamics, which means that the calculated cross sections should be exact except for errors introduced by the CS approximation, and the latter are expected to be less than 30%. The results presented for all four isotopes include: reaction probabilities as a function of energy E and total angular momentum J, total and state to state integral cross sections (including an analysis of product state distributions), and thermal and state resolved rate constants. Comparison of the results with those of several previous dynamical calculations on the same or similar surfaces is made and the accuracy of the approximations made in those calculations is assessed. For example, the product rotational distributions predicted by vibrationally adiabatic distorted wave theory are found to be quite close to what we calculate, although the absolute magnitudes of the cross sections are quite different. Comparison with the results of quasiclassical trajectory calculations indicates good agreement of the reactive cross sections well above the classical threshold, but not of the rate constants (because of tunneling) or of isotope ratios. Wigner corrected conventional transition state theory is very inaccurate in predicting rate constants, but a method which uses collinear exact quantum (CEQ) transmission coefficients to correct transition state theory does quite well.

7582 **High-pressure studies of rotational reorientation dynamics: The role of dielectric friction.** Philips, L.A.; Webb, S.P.; Clark, J.H. (Laboratory of Chemical Biodynamics, Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **83**: No. 11, 5810-5821(1 Dec 1985).

Picosecond, time-resolved, fluorescence depolarization spectroscopy is used to measure the rotational reorientation times of rhodamine 6G (R6G) and p-terphenyl (PTP) as a function of solvent viscosity. The viscosity is varied either by changing the solvent or by changing the pressure in a single solvent. The differences between the two molecules, PTP and R6G, provide a means of evaluating the role of solute structure and solute—solvent interactions on the dynamics of rotational reorientation. The rotational behavior of PTP is well described by simple hydrodynamic models as embodied by the Stokes—Einstein—Debye equation. In contrast, the rotational reorientation dynamics of the charged molecule R6G are not well described by these models. It is demonstrated that dielectric friction plays an important role in governing the rotational motion of charged molecules in polar solvents. When the solvent dielectric properties are varied, the dielectric friction model accurately predicts the observed experimental trends under a wide variety of experimental conditions. This model is also shown to explain anomalous effects previously attributed to the presence of solute—solvent hydrogen bonded complexes.

7583 **Molecular dynamics test of the Brownian description of Na^+ motion in water.** Wilson, M.A.; Pohorille, A.; Pratt, L.R. (Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **83**: No. 11, 5832-5836(1 Dec 1985).

The autocorrelation function of the velocity of an infinitely dilute Na^+ ion in aqueous solution, and the autocorrelation function of the force exerted on a stationary Na^+ under the same conditions are evaluated by molecular dynamics calculations. The results are used to test the accuracy of Brownian motion assumptions which are basic to hydrodynamic models of ion dynamics in solution. The self-diffusion coefficient of the Na^+ ion predicted by Brownian motion theory is (0.65 +- 0.1) x 10^{-5}cm^2/s. This value is about 60% greater than the one obtained for the proper dynamics of the finite mass ion, (0.4 +- 0.1) x 10^{-5}cm^2/s. The numerically correct velocity autocorrelation function is nonexponential, and the autocorrelation of the force on the stationary ion does not decay faster than the ion velocity autocorrelation function. Motivated by previous hydrodynamic modeling of friction kernels, we examine the approximation in which the memory function for the velocity autocorrelation function is identified with the autocorrelation function

of the force on the stationary ion. The overall agreement between this approximation for the velocity autocorrelation function and the numerically correct answer is quite good.

7584 **Total electron yield measurements of extended x-ray absorption fine structures (EXAFS) of Ni and Fe thin foils, and adsorption of Ni on polycrystalline Fe substrates.** Sham, T.K.; Carr, R.G. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **83**: No. 11, 5914-5922(1 Dec 1985).

X-ray absorption spectra of Fe and Ni K edges have been obtained at room temperature by means of a total electron yield technique for a clean Fe foil on which Ni was subsequently deposited, and a Ni foil. This technique involves the measurement of the specimen current. The total yield is found to be $\sim 1 \times 10^{-2}$ electron per photon absorbed at the Fe K edge for a 1/4 mil foil. Dramatic increase in surface sensitivity is gained over transmission EXAFS by using this technique to study Ni overlayers on Fe surface. The EXAFS of the deposited Ni overlayers (several monolayer coverage) are compared with those of the pure elements and of Ni/Fe alloys in the α(bcc) and γ(fcc) phases. The results indicate that the average Ni—Ni bond in the deposited Ni overlayers does not contract relative to that in the bulk in contrast to previously observed contraction of Ni deposition on carbon substrates. The feasibility of this technique and its application are discussed.

7585 **Electron energy loss spectroscopy (EELS) of CH_3NH_2 adsorbed on Ni(100), Ni(111), Cr(100), and Cr(111).** Baca, A.G.; Schulz, M.A.; Shirley, D.A. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **83**: No. 11, 6001-6008(1 Dec 1985).

Adsorbed CH_3NH_2 has been studied on Ni(100), Ni(111), Cr(100), and Cr(111) at 300 K using electron energy loss spectroscopy. The vibrational spectra indicate that molecular CH_3NH_2 exists on all four surfaces with bonding through the nitrogen lone pair, although a substantial amount of dissociation also occurs on the chromium surfaces. Approximately one monolayer of surface species is the stable coverage on each surface at 300 K. The possible existence of coadsorbed dissociation products CH/sub x/ and NH/sub x/ is discussed. The CN stretch is anomalously broad on Ni (100) and Ni(111) but not detectably broadened on Cr(100), indicating a strong sensitivity of this bond to interactions with the Ni surfaces. A multiplicity of sites is indicated on Cr(111) by the breadth of all the peaks. The loss spectra exhibit striking intensity differences, which can be attributed partly to impact scattering and partly to intrinsic differences in the interaction of CH_3NH_2 with the different surfaces. A model explaining the linewidth and intensity differences is proposed.

7586 **Reactivity of HO_2/O^-_2 Radicals in Aqueous Solution.** Bielski, B.H.J.; Cabelli, D.E.; Arudi, R.L.; Ross, A.B. (Chemistry Department, Brookhaven National Laboratory, Upton, NY 11973). *Journal of Physical and Chemical Reference Data;* **14**: No. 4, 1041-1100(Oct 1985). Contract AC02-76ER00038.

Kinetic data for the superoxide radical (HO_2arrow - right - leftO^-_2 $+H^+$, pK = 4.8) in aqueous solution have been critically assessed. Rate constants for reactions of O^-_2 and HO_2 with more than 300 organic and inorganic ions, molecules and other transient species have been tabulated.

7587 **Thermodynamic properties of zirconium ditelluride $ZrTe_2$ to 1500 K.** Johnson, G.K.; Murray, W.T.; Deventer, E.H. van; Flotow, H.E. (Argonne National Lab., IL, USA). *Journal of Chemical Thermodynamics;* **17**: No. 8, 751-760(Aug 1985).

Low temperature (5 to 350 K) heat capacity, fluorine combustion, and high-temperature (350 to 1500 K) drop-calorimetric measurements have been performed on a specimen of zirconium ditelluride $ZrTe_2$. Thermodynamic quantities are reported at T = 298.15 K: the standard molar enthalpy of formation, Δsub(f)H°sub(m)(T) = -(294.1 +- 6.7) kJ.mol^{-1}; the standard molar heat capacity, C°sub(p,m)(T) = (74.11 +- 0.37) J.K^{-1}. mol^{-1}; the standard molar entropy, S°sub(m)(T)=(124.24 +-0.63) J.K^{-1}.mol^{-1}; and the standard molar Gibbs energy of formation, Δsub(f)G°sub(m)(T) = -(290.0 +- 6.7) kJ.mol^{-1}, all with p^0 = 101325 Pa. The thermodynamic properties of $ZrTe_2$ have been calculated to 1500 K.

7588 **Numerical test on the equivalence of intramolecular potential expansions in normal and valence displacement coordinates for H_2O.** Maessen, B.; Wolfsberg, M.; Harding, L.B. (Univ. of California, Irvine). *Journal of Physical Chemistry;* **89**: No. 15, 3324-3325(18 Jul 1985).

A numerical test is presented on the equivalence of potential expansions in normal and valence displacement coordinate space by calculating the lower vibrational states in a vibrational procedure. The calculations are performed for H_2O and they indicate that a fourth-order Taylor series expansion in valence coordinates is not well represented by an expansion in normal coordinates which is truncated at fourth order. 13 references, 1 table.

7589 **Isothermal equilibrium pressures of Y-Th alloy-H_2 system.** Tanase, M.; Fisher, P.W. (Oak Ridge National Lab., TN, USA). *Journal of the Less-Common Metals;* **109**: No. 2, 233-240(15 Jul 1985).

Isothermal equilibrium pressures of the Y_4Th (3:2 by weight) alloy-H_2 system were measured as a function of atomic composition [H]/[Y + Th] in the temperature range 580-1160 K. The isotherms have two plateaux in the pressure range 10^2-10^3 Pa. The first plateau region is attributed to the formation of YH_2, and the equilibrium pressure P in pascals was found to be log P = 12.36 - 11300/T where T is in kelvins. The second plateau is attributed to the formation of ThH_2, and the equilibrium pressure was found to be log P = 10.66 - 6891/T. In low atomic composition region the system obeys Sieverts' law.

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REFER ALSO TO CITATION(S) 6893, 6896, 6897, 7539, 7541, 7542, 7570, 7571, 7572, 7602

7590 (CONF-831025—, pp 69-74) **Laser spectroscopic studies of solvation phenomena.** Wirth, M.J. (Univ. of Wisconsin, Madison). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Two-photon spectroscopic measurements have been shownto provide solvation structural information. The principles of this method are outlined and applications under current study are given. Future spectroscopic measurements on the picosecond time scale promise to provide independent information about the dynamics of solvation interactions. 7 refs., 4 figs.

7591 (CONF-831025—, pp 75-87) **Laser spectroscopic studies of vibrational overtones. Influence of molecular conformation on overtone energies.** Fang, H.L.; Swofford, R.L. (Standard Oil Co., Warrensville Heights, OH). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Intracavity cw dye laser photoacoustic spectroscopy is an extremely sensitive way of studying vibrational overtones in gas-phase samples. New details of the influence of conformation on bond strength are revealed. 4 refs., 5 figs.

7592 (DOE/ER/04987—6, pp 6, Paper 2) **Selective oxidation of hydrocarbons.** 1985. NTIS, PC A03/MF A01. File Number DE86003516. Contract AC02-78ER04987.

In Solid state, surface and catalytic properties of oxides. Progress report, October 1984-September 1985.

Selective oxidation of hydrocarbons is a very important industrial process. In view of the fact that the future feedstock is the less reactive alkanes, there is a need to discover new catalysts for new processes. To guide in the search for new catalysts, two of the most important questions to ask are: (1) what determines selectivity, and (2) how can catalysts be prepared to change selectivity system-

atically. Our present effort is to attempt to seek answers for these questions from existing data. 4 refs., 1 tab.

7593 **(DOE/OT/21400—T3) Physical properties of chlorotrifluoroethylene polymers as a function of molecular weight. II. Molecular fractionation, density, viscosity, molecular weight and the correlation of these properties of chlorotrifluoroethylene polymers.** Gabbard, J.L.; Amis, E.S.; Hendrickson, J.R.; Orrick, N.C.; Dietrich, J.F.; Williams, F.V.; Quinton, A.J.; Alvarez, R.; LaMarr, W.W.; Anderson, V.E. (Carbide and Carbon Chemicals Corp., Oak Ridge, TN (USA)). 15 Jan 1948. Contract AC05-84OT21400. 43p. (K—124). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003597.

A number of randomly selected samples from different lots of chlorotrifluoroethylene polymer were separated by the use of falling-film type molecular stills into fractions with molecular weights ranging from approximately 400 to 1300. Family trees of each sample, showing its physical properties, are presented. The densities, viscosities, and molecular weights of the various fractions were determined with a high degree of accuracy. These data are presented and are correlated graphically. Empirical equations were derived which accurately express the relationships between density and molecular weight, viscosity and molecular weight, and viscosity and density of the respective fractions. The deviations of the calculated from the observed values for a number of randomly selected fractions are shown in tables.

7594 **(DOE/OT/21400—T5) Physical properties of chlorotrifluoroethylene polymers. III. Density and viscosity of chlorotrifluoroethylene polymers as a function of temperature.** Gabbard, J.L.; Alvarez, R.; Dietrich, J.F.; Lemarr, W.W. (Carbide and Carbon Chemicals Corp., Oak Ridge, TN (USA)). 31 Dec 1948. Contract AC05-84OT21400. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003598.

The densities and viscosities of three different lots of chlorotrifluoroethylene polymers and a residue and distillate from the molecular distillation of one of these lots were investigated as a function of temperature. The data are presented, tabulated, and equations and graphs showing the relationships are presented. The viscosity index for these oils is also given. For purposes of comparison, an equal number of samples of fluorolube oils with an approximate composition of $C_{21}F_{44}$ were investigated. 5 refs., 3 figs., 2 tabs.

7595 **(DOE/OT/21400—T11) Correlation of critical temperatures with thermal expansion coefficients of liquid fluorocarbons.** Rutledge, G.P. (Carbide and Carbon Chemicals Corp., Oak Ridge, TN (USA)). 13 Jun 1949. Contract AC05-84OT21400. 17p. (K—419). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003593.

The critical temperatures of decafluorobis(trifluoromethyl)cyclohexane, dichlorooctafluorobis(trifluoromethyl)cyclohexane, undecafluoro(trifluoromethyl)cyclohexane, bis(trifluoromethyl)-benzene, and hexadecafluoroheptane are predicted from thermal expansion data to be 240.1, 334.1, 207.4, 276.4, and 194.9°C respectively. These predicted values when compared with experimentally determined critical temperatures show an agreement within 2%. 1 ref., 4 figs., 6 tabs.

7596 **(GAT-T—3372) Study of Clor-N-Oil 50 PCB screening kits on waste oil samples.** Bertram, F.J. Jr. (Goodyear Atomic Corp., Piketon, OH (USA). Measurement Services Dept.). 22 Nov 1985. Contract AC05-76OR00001. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003752.

Twenty "Clor-N-Oil 50" PCB screening kits were tested with a variety of oil samples to determine whether they are suitable for identifying waste oils not contaminated with PCB's. Reliable results were obtained with clean transformer oils for which these kits were designed. Unreliability associated with use on waste oil samples renders them not cost-effective for use on waste oil. 2 refs., 2 tabs.

7597 **(UCRL—93619) Measurements of CH radical concentrations in an acetylene/oxygen flame and comparisons to modeling calculations.** Joklik, R.G.; Daily, J.W.; Pitz, W.J. (California Univ., Berkeley (USA); Lawrence Livermore National Lab., CA (USA)). 1 Oct 1985. Contract W-7405-ENG-48. 31p. (CONF-8510158—5). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003887.

From Two phase combustion, numerical modelling of combustion processes: general combustion topics; Davis, CA, USA (21 Oct 1985).

Absolute $CH(X^2\Pi)$ and $CH^*(A^2\Delta)$ concentrations have been measured in a low pressure C_2H_2/O_2 flat flame laser absorption and emission spectroscopy. The effect of equivalence ratio, pressure, and temperature on CH and CH* concentrations were investigated. Both species concentrations were found to peak at approximately stoichiometric conditions and exhibited strong temperature dependences. In an 1800 K flame at 40 torr the peak CH concentration was 24 ppM while CH* was about 1000 times less (0.018 ppM). At all conditions studied, the maximum CH* concentration occurred closer to the burner than that of CH. Calculated CH concentrations using a detailed chemical kinetic mechanism and literature values for the rate constants agreed within a factor of 2 with experiment. Predicted CH* concentrations were approximately one order of magnitude below those measured. 34 refs., 12 figs., 3 tabs.

7598 **Correlation of ligand field excited-state energies with ligand field strength in (polypyridine)ruthenium(II) complexes.** Wacholtz, W.M.; Auerbach, R.A.; Schmehl, R.H.; Ollino, M.; Cherry, W.R. (Tulane Univ., New Orleans, LA). *Inorganic Chemistry;* **24**: No. 12, 1758-1760(5 Jun 1985).

The temperature dependence of the emissions intensities and lifetimes for several (polypyridine)ruthenium(II) complexes have been evaluated. For complexes that have weaker ligand fields than tris(bipyridine)ruthenium(II), a dramatic decrease in the emission intensity and lifetime occurs near 170 K. This behavior is ascribed to population of a ligand field state that lies only 2000 cm^{-1} above the lowest metal-to-ligand charge-transfer excited state. Above 250 K, a weak emission remains and an additional activated process can be observed in the vicinity of 260-330 K. This weak emission is assigned to emission from an impurity, most likely tris(bipyridine)ruthenium(II).

4004 ELECTROCHEMISTRY

REFER ALSO TO CITATION(S) 7431, 7552

7599 **New uses of nafion membranes in electro-organic synthesis and in organic acids separations.** Chum, H.L.; Hauser, A.K.; Sopher, D.W. (Solar Energy Research Inst. Golden CO). *Journal of the Electrochemical Society;* **130**: No. 12, 2507-2509(Dec 1983).

Nafion perfluorosulfonate ion exchange membranes and chemically similar analogs are being widely used in electrolytic processes because of their excellent chemical and thermal stability, high conductivity, and permselectivity, and suitability of mechanical properties. In this communication we report new uses of Nafion, applicable to other cation-exchange membranes in organic electrosynthesis and in the separation of carboxylic acids.

4005 PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 7106

7600 **(LBL—20109) Molecular beam studies of electronic state-selective photochemistry.** Butler, L.J. (Lawrence Berkeley Lab., CA (USA)). Oct 1985. Contract AC03-76SF00098. 302p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE86004018.

The evolution of a specifically excited molecule to its final fragmentation products is studied here for three photochemical systems by the crossed laser-molecular beam technique. Measurement of product velocity distributions and polarization dependences allows elucidation of details of all pathways from excitation

through fragmentation. The photodissociation of CH_2BrI has been studied at 248.5, 210, and 193.3 nm. The dissociation of nitromethane following excitation of the π^* reverse arrow π transition at 193 nm has been investigated by product emission spectroscopy and molecular beam photofragmentation translational energy spectroscopy. Dissociation pathways of a vibrationally excited molecule in the ground electronic state have been studied in the infrared multiphoton dissociation of diethyl ether. 100 refs., 76 figs., 5 tabs.

7601 **Observation of CH_3O in the collision free multiphoton dissociation of CH_3NO_2.** Wodtke, A.M.; Hintsa, E.J.; Lee, Y.T. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **84**: No. 2, 1044-1045(15 Jan 1986).

A continuous, seeded, molecular beam of nitromethane was passedthrough a heated (580 °K) nozzle, thus eliminating cluster formation. The CH_3NO_2 was dissociated by IR radiation from a CO_2 laser. The time of flight spectrum was observed at masses 46, 30, 29, and 15. (AIP)

4006 RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 7045, 7586

7602 **Gas-phase reactions of atomic chlorine with vinyl fluoride.** Iyer, R.S.; Chen, C.Y.; Rowland, F.S. (Univ. of California, Irvine). *Journal of Physical Chemistry;* **89**: No. 10, 2042-2048(9 May 1985).

The addition of thermal chlorine atoms of vinyl fluoride has been studied over the pressure range from 50 to 4000 torr using thermalized ^{38}Cl atoms from neutron irradiation of $CClF_3$. Thermal chlorine atoms show a preference for addition to CH_2 vs. CHF in CH_2 = CHF of 1.9 +/- 0.1 at 20°C, and a total rate constant for the sum of the two addition reactions of (1.85 +/- 0.20) x 10^{-10} cm^3 $molecule^{-1}$ s^{-1}. Experiments carried out over the temperature range from 232 to 338 K show essentially no change in total reactivity by addition to CH_2 = CHF relative to abstraction of H from HI. The relative addition to the two ends of CH_2 = CHF changes over this temperature range, consistent with a lower activation energy for addition to CH_2 by 500 to 700 cal/mol. In contrast, the only literature value for a theoretical estimate of this preference for anti-Markownikoff addition gives an activation energy difference of 5400 cal/mol in CH_2 = CHF. The total rate constant for addition to CH_2 = CHF is the same within experimental error as for addition to CH_2 = CH_2. Reversible loss of ^{38}Cl is observed from both $CH_2{}^{38}ClCHF$ and $CH_2CH^{38}ClF^*$ radicals at lower pressures, with decomposition equal to stabilization at about 230 and 160 torr, respectively. By analogy with these CH_2 = CHF observations, the addition of thermal ^{38}Cl to CH_2 = CHBr is postulated to occur in comparable yields at both ends of the molecule, rather than with a strong preference for addition at the CH_2 end. 25 references, 5 figures, 2 tables.

7603 **Protonation of the reduced species in irradiated acetonitrile.** Mulac, W.A.; Bromberg, A.; Meisel, D. (Argonne National Lab., IL, USA). *Radiation Physics and Chemistry;* **26**: No. 2, 205-209(1985).

The rate of the reaction of the radiolytically produced reduced species in acetonitrile with various protic solvents (alcohols and water) was measured by the competition method and by directly following the rate of disappearance of the reduced species in pulse radiolytic experiments. The rate constants thus obtained were correlated with the pKsub(a) of the protic additives. This correlation leads to the conclusion that the reaction occurs via a proton transfer. Temperature effect studies on the rate of this reaction lead to the conclusion that the reactive species is the dimer anion radical $(CH_3CN)_2$.

4007 RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

REFER ALSO TO CITATION(S) 7544, 7552

7604 **(MLM—3319(OP)) Central gas analysis laboratory with remote sampling.** Ellefson, R.E.; Morgan, F.E.; Anderson, B.E. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1985. Contract AC04-76DP00053. 17p. (CONF-851174—17). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003729.

From 32. national vacuum symposium and topical conference; Houston, TX, USA (19 Nov 1985).

A computerized central analytical facility is described which remotely samples from 70 process points and analyzes the gas samples by mass spectrometry and other analytical techniques. Samples are transported through a capillary by pressure gradient to a vacuum manifold and ultimately to the inlet systems of either of two mass spectrometers. Process pressures vary from 400 to 2500 Torr which assures viscous, non-separative flow within the capillaries, the capillary whose inside diameters range from 0.3 to 0.5 mm. An exhaust-gas recovery system to retain valuable tritium from samples is also described. The sampling manifold and inlet systems are fabricated from high vacuum components and tubing that is polished on interior surfaces. All valves can be computer controlled or manually operated from a central control console. Valve actuation is vertified by process changes. The gas is analyzed by a computer-controlled magnetic-sector mass specrometer, the results archived in another computer and the approved results sent to the requestor via a data network. 4 refs., 6 figs.

7605 **(SKB-KBS-TR—84-15) Sorption of Cs, I, and actinides in concrete systems.** Allard, B.; Eliasson, L.; Andersson, K. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Sep 1984. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86700206.

Samples of seven different concretes were prepared (Standard Portland cement of two kinds; sulphate resistant, blast furnace slag, high alumina, fly ash, and silica cements) and the corresponding pore waters were analyzed. Batch-wise distribution studies were performed in the various concrete/pore water systems, as well as for three old concrete samples from a hydro power station dam (more than 60 years old), for the elements Cs, I, Th, U, Np, Pu, and Am at trace concentration levels. Generally the sorption of Cs was low, and somewhat higher for I. All the actinides, including U and Np in their hexa- and pentavalent states, respectively, were strongly sorbed on the cement phase.

7606 **(YJT—85-12) Leachability of cesium from cemented evaporator concentrates and ion-exchange resins.** Muurinen, A. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Mar 1985. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86700207.

Leachabilities of cesium from cemented evaporator concentrates and ion-exchange resins were measured. The standard draft of the International Organization for Standardization (ISO, 1979) for long-term leach testing was followed in the research. Three resin concretes and three concentrate concretes were tested. Deionized water and ground water were used as leachants. The leaching temperature was 20-23 deg C. The incremental leach rate at the end of the three and a half year test varied between 5 x 10^{-13} - 15 x 10^{-13} m/s and the cumulative activity fraction leached between 1.5 x 10^{-3} - 6 x 10^{-3} m. The apparent diffusion coefficients in ground water varied between 10^{-9} - 10^{-8} m/day. Because of the cracking the specimens cannot, however, be regarded as whole blocks, but the effects of cracking should be taken into account.

4008 COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

7607 (DOE/ER/04650—T2) Research in nonlinear problems of energy. Progress report. (Northwestern Univ., Evanston, IL (USA). Dept. of Engineering Science and Applied Mathematics). 31 Oct 1985. Contract AC02-78ER04650. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003362.

The primary emphasis of this program is on the applications of Bifurcation and Stability Theory to Problems of energy, with specific emphasis on Problems of Combustion and Flame Propagation. In particular we consider the problem of transition from laminar to turbulent flame propagation. A great deal of progress has been made. A total of eighty eight papers citing this project have been prepared for publication in technical journals. A listing of the papers is appended to this report. In addition a brief summary of the results is also appended.

7608 (DOE/ER/10947—4) Behavior of matter under nonequilibrium conditions: fundamental aspects and applications in energy-oriented problems. Prigogine, I. (Texas Univ., Austin (USA). Center for Studies in Statistical Mechanics). 1985. Contract AS05-81ER10947. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003771.

During the past year we attempted to clarify the way bifurcations of periodic solutions are organized near a homoclinic orbit associated with an unstable periodic solution. Our principal motivation is to explain various types of bifurcations sequences observed in nonlinear dynamic. 15 refs., 5 figs.

7609 (N—84-22727) Mechanism of soot formation in preximed C2H2/O2 flames. Delfau, J.L.; Vovelle, C. (Centre National de la Recherche Scientifique, 45 - Orleans-la-Source (France). Centre de Recherches sur la Chimie de Combustion et des Hautes Temperatures). 1983. 25p. NTIS, PC A02/MF A01.

Neutral species in rich C2H2/O2 premixed flat flame stabilized under reduced pressure were analyzed by coupled molecular beam-mass spectrometry. In order to investigate whether particular variations are observed at the sooting limit (2.1) 6 flames of equivalence ratio 1.8, 2.0, 2.1, 2.2, 2.6 and 3.0 were studied. The roles played by polyacetylenic hydrocarbons and polycyclic aromatic hydrocarbons (PAH) in the mechanism of soot formation were compared. Profiles of mole fraction and mass fraction flux versus distance to the burner show that polyacetylenics cannot be considered as active intermediates. A strong reactivity is observed at the boundary between oxidation and soot formation zones for PAH. Variation of the profiles of mass fraction flux for species containing one to six carbon atoms, and the role played by deshydrogenation reactions were studied. Results suggest that C4H4 plays a major role in the first step of the mechanism of soot formation. (ESA)

7610 (SAND—82-8773) Interface scheme for turbulent flame propagation. Barr, P.K.; Ashurst, W.T. (Sandia National Labs., Livermore, CA (USA)). Apr 1984. Contract AC04-76DR00789. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003567.

Turbulent flame propagation in a premixed combustible gas is studied by replacing the flame structure with an idealized reaction front of zero thickness. The flow is computed with an algorithm designed to track an interface between two fluids. The interface scheme is used to compute the movement of a reaction front due to flow convection and flame propagation. To investigate the effect of turbulence on flame propagation, we use a computational domain that is a two-dimensional square with periodic boundaries. Turbulent flow is established with a random distribution of several hundred vortices of randomly varying size and strength. Combustion is initiated along a central strip so that two flame fronts are created in the square. The turbulent flame speed is determined from the rate of product formation in the square. The density change across the flame is neglected, and either a constant burning velocity normal to the interface or a velocity that additionally depends on flame curvature is used. The zero-thickness flame results agree with previous detailed calculations of mass and energy diffusion, and thus model to a good approximation a flame with finite thickness. These results show that at constant turbulence length scale the flame speed increases linearly with turbulence intensity, and at constant turbulence intensity the flame speed increases with decreasing turbulent length scale. The agreement indicates that for the range of turbulence parameters studied, enhanced internal energy transport in the flame zone due to turbulence is not an important factor in increasing the flame speed. Rather, the increase is due to the increase in the flame area caused by the turbulence. 11 refs., 5 figs., 1 tab.

42 ENGINEERING

4201 GENERAL ENGINEERING

7611 (DOE/ER/13038—T2) Turbulent premixed flame study. Progress report, December 1, 1984-August 31, 1985. Cheng, W. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). 10 Sep 1985. Contract AC02-83ER13038. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86002129.

Substantial progress has been made last year in the turbulent premixed flame study program. A large body of data on the development of free flame balls using high speed Schlieren movies was collected and analyzed. Some of the features are highlighted in section II. The theoretical development of a joint velocity/progress variable probability density distribution has been completed. A Monte Carlo calculation of this pdf based on the experimentally measured turbulence conditions has yielded a flame growth history in excellent agreement with that recorded in the high speed Schlieren movie. The results are described in section III. The remaining work to be done in the three months (December 1, 1985 to February 28, 1986) extension of the original contract is outlined in section IV. This work will involve the continuation of the data analysis on the global behavior of statistically spherical flames, and a new activity of probing into the internal structure of these flames. The budget for this period is listed in section V.

7612 (LA-UR—85-3834) Workshop on standards for photonic streak camera characterization. Stradling, G.L. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 6p. (CONF-850887—41). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002430.

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

A summary paper proposing standardization of definitions and parameter measurements related to photonic streak cameras was generated at the 16th International Congress of High Speed Photography and Photonics at Strasborg, France (August 1984). An international committee appointed by the general Workshop on Picosecond Streak Cameras met and discussed the areas appropriate for standardization and proposed specific definitions, measurements and complementary parameter sets to be used in characterizing photonic streak cameras. These proposals were compiled into a summary paper by the committee co-chairmen, Noel Fleurot (CEA-Limeil) and Gary L. Stradling (Los Alamos National Laboratory), with the intent that it be distributed to interested streak camera users and manufacturers and that appropriate improvements and additions be solicited.

7613 (SAND—85-1301C) Modal analysis of a shell-payload structure using test data. Carne, T.G.; Martinez, D.R.; Tucker, M.D.; Lauffer, J.P. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 11p. (CONF-860224—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002588.

From 4. international modal analysis conference; Los Angeles, CA, USA (3 Feb 1986).

This study evaluates the accuracy of computed modal frequencies obtained from a combined experimental/analytical model for a shell-payload structure. The total structure is physically divided into two subsystems, the shell and the internal payload, which are connected through a stiff joint. The payload was tested to obtain its free modes, while a finite element model of the shell was analyzed to obtain its modal description. A component mode syn-

thesis technique was investigated which incorporates free modes and residual flexibility. The experimental modal data base for the payload was directly coupled with the finite element modal model of the shell to create an experimental/analytical model of the total structure. Both the translational and rotational elements of the payload mode shapes at the interface were measured and used in the coupling. The modal frequencies, computed using the combined experimental/analytical model, were then compared to those from a modal test of the entire structure. The sensitivity of the combined model to the residual flexibilities was also determined. Finally, recommended procedures for developing combined experimental/analytical models of shell-payload structures are given.

7614 **(SLAC-PUB—3793) Implementation and operating experience with a centralized multi-disciplinary CAD CAM System.** Larsen, R.S.; Steffani, J.P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1985. Contract AC03-76SF00515. 7p. (CONF-851060—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003860.

From 4. DOE workshop on computer aided engineering; Upton, NY, USA (10 Oct 1985).

The Stanford Linear Accelerator Center (SLAC) has installed a centralized CAD CAM System to support Electronics, Mechanical, Mechanical Fabrication and Architectural Engineering and Design. The various phases of implementing this system are described, including problems of selection, system software support, maintenance, training, performance evaluation, and future expansion. Some emphasis will be given to the experience with the Electronics disciplines.

7615 **(UCID—20348) Intense electron beams for directed energy weapons research.** Smith, A.C. Jr. (Lawrence Livermore National Lab., CA (USA)). Jan 1985. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002858.

This report is the script for the film "Intense Electron Beams for Directed Energy Weapons Research."

7616 **(LA-tr—85-54) New model of universal gas-filled neutron tube.** Bespalov, D.F.; Bessarabskii, I.G.; Voitsik, L.R.; Mints, A.Z. (Los Alamos National Lab., NM (USA); Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1985. Contract W-7405-ENG-36. Translated from Skvazhinnye generatory neitronov, ONTI VNIIIAGG, Moscow, USSR, 1973, 65-80. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002861.

The UNG-1 gas-filled neutron tube is serially produced. In type UNG neutron generators, the tube operates in the pulsed mode in the high voltage doubling circuit arrangement. During extended operation, its advantages were discovered: long operating time, fairly stable neutron yield, and simplicity of use and operation. However, the mean neutron yield ($\sim 10^7$ s^{-1}) generated by the tube in the optimal mode at the present time proved to be inadequate in solving numerous geophysical problems. So a model of a neutron tube, model UNG-2, was designed, ensuring an enhanced neutron yield of 10^8 s^{-1} in the continuous-operating mode. When the tube is connected to the high voltage doubling circuit, the mean neutron yield is only somewhat in excess of the neutron yield from the UNG-1 tube.

4202 FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 6921, 6984, 7050, 7058, 7178, 7186, 7220, 7241, 7604, 8091, 8092, 8097, 8099, 8100, 8107, 8112, 8114, 8115

7617 **(AD-A—155261/1/XAB) Research on design of cryotransformers and its prospects for the future.** Lech, W. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 28 Feb 1985. 27p. (FTD-ID(RS)T—1548-84). NTIS, PC A03/MF A01.

Calculation results of the technical-economic parameters of large power cryotransformers with windings of pure aluminum, presented in this paper, indicate that the production of such cryotransformers could be justified and that resumption of the research work in this field would be advisable. On the basis of significant progress in the development of new multifilament superconducting wires it was concluded that the construction of cryotransformers with superconducting windings will become feasible in the near future, and that most likely these windings will operate at the temperature of liquid hydrogen.

7618 **(BDX—613-3338) Thread milling on N/C and CNC milling machines. Final report.** Ashbaugh, F.A.; Murry, K.R. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Dec 1985. Contract AC04-76DP00613. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004384.

A unique thread-cutting tool design has been developed which permits threading of internal or external features; right- or left-hand threads; and standard, metric, or special pitches within a given size range without changing tools. One of the major advantages of the technique is the ability to produce small threads on N/C and CNC milling manchines. This study presents results showing fabrication of quality threads as small as number 0-80 in selected materials.

7619 **(CEA-CONF—7597) Nb metallurgical tranformations occuring in the microbridge area of an RF SQUID during its critical current adjustment.** Monford, Y.; Bloyet, D.; Villegier, J.C.; Duret, D. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Sep 1984. 4p. (CONF-840937—34). NTIS (US Sales Only), PC A02. File Number DE86750302.

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

We describe the metallurgical transformations of Nb thin-film Dayem microbridges related to the adjustement of their critical current at operating temperature (4.2 K). The critical current is reduced to a few tens of microamperes when the microbridge is submitted to proper current pulses. Subsequent Transmission Electron Microscopy (TEM) observations show an increase of the mean Nb grain size in the microbridge area. Nb contamination by the silicon substrate is also observed. Both critical temperature and critical current decreases are attributed to these phenomena.

7620 **(CEA-CONF—7760) Recent results on SIS mixers at LETI (Grenoble) and ENS (Paris) with Nb/Ox/PbIn and NbN/Ox/PbIn junctions.** Regent, A.; Zaquine, I.; Matheron, G.; Villegier, J.C.; Pernot, J.C.; Letrou, C.; Crete, D.; Encrenaz, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Sep 1984. 5p. (CONF-8409281—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE86750301.

From 14. European solid state device research conference including solid state device technology; Lille, France (10 Sep 1984).

Superconducting thin film tunnel junctions with a niobium or niobium nitride base electrode and lead-indium counter electrode have been made and tested with success at LETI (Grenoble) and ENS (Paris) at 35 GHz in mixing experiments. NbN junctions gave double side band mixer noise temperatures of about 70K with 7 dB conversion loss. NbN is expected to be a very good material for applications at frequencies above 115 GHz due to its large energy gap, compared to the usual tin or lead alloys.

7621 (CONF-831025—, pp 227-233) **New facility for high resolution inductively coupled plasma-atomic multielement emission spectroscopy of radioactive materials.** Edelson, M.C.; Fassel, V.A. (Ames Lab., IA). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

An inductively coupled plasma excitation system has been designed to operate within a total α-containment structure. The design, testing and operation of the system is discussed and some optical emission spectra of Pu-242 and U-isotopes are presented. The entire experimental process, from sample weighing to waste collection, was performed within a single glovebox. During the testing and redesign phase of this study, unanticipated failure modes were encountered, thus demonstrating the need for extensive testing of such devices before they are used with hazardous materials. 3 figs.

7622 (CONF-831025—, pp 235-239) **Plans for inductively coupled plasma atomic emission spectroscopy (ICP-AES) analysis of impurities in plutonium materials at Rocky Flats.** Michel, C.E.; Brown, G.E. (Rockwell International, Golden, CO). 1984. NTIS, PC A17/MF A01. File Number DE85014573.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

Due to the complex emission spectra of plutonium, ICP analysis of impurities in plutonium materials requires an effective and efficient separation of the impurities of interest from the plutonium matrix. The use of dihexyl N-N diethylcarbamoylmethylenephosphonate (DHDECMP) in the extraction and separation of plutonium and americium from impurities of interest has been evaluated and shown to meet these requirements. Topics discussed in this paper are: (1) a proposed method for the determination of impurities in plutonium metal; (2) recovery of plutonium from DHDECMP and recycle use of DHDECMP; (3) instrument and equipment plans. 5 refs., 1 fig., 2 tabs.

7623 **(CONF-851115—26) Economics of the specification 6M safety re-evaluation and regulatory requirements.** Hopper, C.M. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002182.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The objective of this work was to examine the potential economic impact of the DOT Specification 6M criticality safety re-evaluation and regulatory requirements. The examination was based upon comparative analyses of current authorized fissile material load limits for the 6M, current Federal regulations (and interpretations) limiting the contents of Type B fissile material packages, limiting aggregates of fissile material packages, and recent proposed fissile material mass limits derived from specialized criticality safety analyses of the 6M package. The work examines influences on cost in transportation, handling, and storage of fissile materials. Depending upon facility throughput requirements (and assumed incremental costs of fissile material packaging, storage, and transport), operating, facility storage capacity, and transportation costs can be reduced significantly. As an example of the pricing algorithm application based upon reasonable cost influences, the magnitude of the first year cost reductions could extend beyond four times the cost of the packaging nuclear criticality safety re-evaluation. 1 tab.

7624 **(CONF-851245—1) Learned navigation paths for a robot in unexplored terrain.** Iyengar, S.S.; Jorgensen, C.C.; Rao, S.V.N.; Weisbin, C.R. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001358.

From 2. conference on artificial intelligence applications; Miami Beach, FL, USA (11 Dec 1985).

Finding optimal paths for robot navigation in known terrain has been studied for some time but, in many important situations, a robot would be required to navigate in completely new or partially explored terrain. We propose a method of robot navigation which requires no pre-learned model, makes maximal use of available information, records and synthesizes information from multiple journeys, and contains concepts of learning that allow for continuous transition from local to global path optimality. The model of the terrain consists of a spatial graph and a Voronoi diagram. Using acquired sensor data, polygonal boundaries containing perceived obstacles shrink to approximate the actual obstacles surfaces, free space for transit is correspondingly enlarged, and additional nodes and edges are recorded based on path intersections and stop points. Navigation planning is gradually accelerated with experience since improved global map information minimizes the need for further sensor data acquisition. Our method currently assumes obstacle locations are unchanging navigation can be successfully conducted using two-dimensional projections, and sensor information is precise.

7625 **(DOE/CE/15128—T2) Tubular pneumatic conveyor pipeline. Final technical report.** Ply, L.L. (Ply International, Inc., Windom, TX (USA)). Jun 1985. Contract FG01-82CE15128. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003969.

A grant from the US Department of Energy was awarded to construct and test a section of a pneumatic conveying system to acquire validation of the technology and economics of the system. A section of the line was constructed and tested at the Milchem Barite Grinding Plant located at Galveston, Texas. Granular Barium Sulphate, (barite) was used as the test material. A range of tests were conducted and modifications made to the fluidizing line and uni-directional valves to optimize the efficiency of the system. The test line proved superior to conventional pneumatic conveying lines by increasing the product conveying rate from fifty-six (56), tons per hour with a conventional system to one hundred and forty (140) tons per hour. The low vent loss of 2.1% was due to the test line's ability to convey a denser product flow without line plugging than possible with dilute phase conventional systems. The test line was deliberately plugged with material and rapidily unplugged during a series of tests to determine shut-down and start-up capability. This system may be retro-fitted to existing conventional pneumatic conveying lines with only minor modifications.

7626 **(DP-MS—85-32) Shared robotic system: automated pipette calibration and pipette tip filter assembly.** Addison, J.H. Jr.; Dyches, G.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 19p. (CONF-8510206—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000560.

From 3. international symposium on laboratory robotics; Boston, MA, USA (20 Oct 1985).

At the Savannah River Laboratory a Zymate Laboratory Automation System has been developed to perform two completely independent tasks within one work cell. One operation is the precise calibration of pipettes; the other is the assembly of a filter in a pipette tip. Since neither task requires full robot time, the shared system is an economical means of robotizing both processes. These are tedious, repetitive, time consuming tasks; and human operators fail to yield constant results. Automation insures a repeatable process which increases product quality.

7627 **(DP-MS—85-139) Site overview of robotics and automation.** Byrd, J.S. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 10p. (CONF-8511129—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003146.

From RAWG robotic and automation workshop; Los Alamos, NM, USA (21 Nov 1985).

This paper summarizes the robotics and automation activities at the Savannah River Laboratory and the Savannah River Plant. The purpose is to provide an overview to facilitate the exchange of technology between various sites involved in development and production work for the Department of Energy. Throughout the paper references are made to assigned project engineers so that they may be contacted directly.

7628 **(LA-UR—85-2943) Low-temperature heat transfer by contact in vacuo, and thermal conductivity of Kapton.** Wipf, S.L. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850920—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002393.

From 9. international conference on magnet technology; Zurich, Switzerland (9 Sep 1985).

Heat transfer between copper surfaces separated by insulators, especially Kapton, has been measured. At 5 K, the copper/Kapton interface conductance is $C = 2.5 +- 0.8\ kWm^{-2}K^{-1}$ and the thermal conductivity is $k = 10 +- 2\ mWm^{-1}K^{-1}$ being inversely proportional to temperature. For mica both C and k are larger, k at least by two orders of magnitude.

7629 **(LA-UR—85-3957) Kinetics of proposed gamma-ray lasers.** Baldwin, G.C. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 14p. (CONF-851053—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003682.

From 7. international workshop on laser interaction and related plasma phenomena; Monterey, CA, USA (28 Oct 1985).

Gamma-ray lasers, although proposed for many years, remain undeveloped because pumping can destroy conditions essential for gain. We review many of the solutions (viz, narrowed-line,

explosive neutron pump, two-stage pump, two-step pump) proposed so far, with emphasis on kinetics. The most promising approach requires fast interlevel transfer from a separated isomer to initiate a superradiant Borrmann mode in a solid host. However, suitable nuclear transitions and nondestructive transfer mechanisms have yet to be identified.

7630 **(LA-UR—85-4034) Spiking mode operation for a uniform-period wiggler.** Warren, R.W.; Goldstein, J.C.; Newnam, B.E. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 22p. (CONF-850956—18). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003665.

From 7. international free-electron laser conference; Tahoe City, CA, USA (8 Sep 1985).

The onset of saturation in a uniform-period wiggler has been examined experimentally and through numerical simulations. Models have been constructed that explain the observations in simple and consistent ways. The models are based upon the development of strong frequency and amplitude modulation of the optical wave as a way to increase extraction efficiency and optical power.

7631 **(LBL—19922) Pulsed plasma jet igniters: molecular beam measurements.** Cavolowsky, J.A.; Edwards, C.F.; Oppenheim, A.K.; Lucas, D. (Lawrence Berkeley Lab., CA (USA)). Oct 1985. Contract AC03-76SF00098. 32p. (CONF-8510158—4). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001991.

From Two phase combustion, numerical modelling of combustion processes: general combustion topics; Davis, CA, USA (21 Oct 1985).

Molecular beam mass spectrometry has been used to determine temperature and species concentrations in the discharge plume of a pulsed plasma jet igniter. Laser schlieren photographs of the plume/sampling cone interaction reveal that the molecular beam sampling has negligible effect on jet fluid mechanids up to the time of impingement, and temperature and species measurements indicate that at later times the gas is sampled from within the plume. The temperature in an atmospheric pressure jet of nitrogen ranged from a maximum of 50,000K to ambient temperature. Peak nitrogen atom concentration at the detector was found to range from 5%, 2mm from the igniter, to less than 100 ppM at 14mm.

7632 **(PNL-SA—13264) Costs of heat exchanger fouling in the US industrial sector.** Smith, S.A.; Dirks, J.A. (Pacific Northwest Labs., Richland, WA (USA)). Jun 1985. Contract AC06-76RL01830. 13p. (CONF-851106—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002816.

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

Heat exchangers are used in many heat source, heat sink and process applications throughout the US industrial sector. In 1984 heat exchanger sales totaled $1.3 billion (in 1984 dollars), and sales are expected to grow at 6% per year through 1985. The presence of fouling in heat exchangers represents an additional cost to the industrial sector in terms of additional capital, energy, and labor. Several estimates are available on the costs of fouling to specific industries; however, no real attempt has been made to estimate these costs for the entire industrial sector. The objective of this paper is to provide on order-of-magnitude estimate of the costs of fouling to the entire US industrial sector.

7633 **(REG/G—3.4) Nuclear criticality safety in operations with fissionable materials outside reactors. Proposed revision 2 to regulatory guide 3.4.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Apr 1985. 7p. US Nuclear Regulatory Commission, Washington, DC 20555. File Number TI85901687.

This guide describes procedures acceptable to the NRC staff for preventing accidental criticality in operations with fissionable materials outside reactors and validating calculational methods used in assessing nuclear criticality safety.

7634 **(RFP—3884) Hot hollow cathode and its applications in vacuum coating. A concise review.** Kuo, Y.S.; Bunshah, R.F.; Okrent, D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; California Univ., Los Angeles (USA)). 1985. Contract AC04-76DP03533. 17p. (CONF-851174—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001564.

From 32. national vacuum symposium and topical conference; Houston, TX, USA (19 Nov 1985).

A concise description of the hollow cathode (HC) effect is given to clarify the confusing terminology and their diverse applications. The cold and hot types of HCs are then discussed. It is followed by a summary of the behavior of the hot HC as an arc generating device, with emphasis on its use for vacuum coating purposes. Two major coating devices, one developed by Ulvac Corp. (Japan) and the other at Rocky Flats Plant (RFP) of Rockwell International (USA), are then reviewed with their respective applications. Review of the latter includes recent results of plume effect upon both the unusual deposition rate distribution and the extremely high substrate (ion) current. The coating morphology and microstructure can be best explained using the Krikorian concept and, when optimized, can help to render very high bonding strength (as high as 90 ksi for 304 stainless steel substrates), with the coatings used as the bonding interlayer. Finally, comments are made concerning the directions of future technology development based on the system features reviewed.

7635 **(SAND—85-0958) Task planning for control of a sensor-based robot.** Lennox, R.C.; Luger, G.F.; Harrigan, R.W. (New Mexico Univ., Albuquerque (USA); Sandia National Labs., Albuquerque, NM (USA)). Dec 1985. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86004225.

This paper is divided into four major sections. The first is an introduction to the research area. The second provides a brief overview of the history of "planning" in artificial intelligence (AI), while the third part of the paper describes the representational power of very-high-level computer languages and how this power may be brought to planning in robotics research. Finally, we describe our PROLOG-driven Planner for controlling a PUMA arm used for object manipulation and note the future directions of this work.

7636 **(UCID—20080-Rev.1) Behavior of very large short pulse antennas. Revision 1.** Buettner, H.M.; Spero, A.J. (Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86004180.

The electromagnetic behavior of a pulsed array of radiating elements can exhibit marked differences from standard continuous wave (CW) behavior when the physical size of the array, D, exceeds the physical pulse length, cT (speed of light times pulse duration). Herein we present a simple analytical model and the results of computer code calculations which explain and illustrate those differences. We further elaborate on the behavior of these very large transient antennas (VLTA) by using computer codes to illustrate the effects on the radiation pattern when the radiators exhibit randomness of turn-on time, phase, or amplitude. Our results show that the physical space into which a linear VLTA radiates can significantly be divided into two regions by the off-axis angle Θ/sub T/ identical to arcsin (cT/D). Within the near-axis region ($\Theta < \Theta$/ sub T/), the behavior of a coherently radiating (pulses simultaneously initiated) array is dominated by a CW antenna pattern. That is, the lobe structure found in the energy-deposition pattern is essentially that of the CW case. In the far-axis region ($\Theta > \Theta$/sub T) the behavior of a coherently radiating array is dominated by transient effects. No CW-like pattern is seen; instead the energy-deposition pattern is roughly proportional to $1/\sin^2\Theta$ with only a suggestion of lobes.

7637 **(UCRL—53643) Design of externally pressurized gas bearings for dynamic applications.** Roblee, J.W. (Lawrence Livermore National Lab., CA (USA)). 30 Sep 1985. Contract W-7405-ENG-48. 211p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86003443.

Externally pressurized gas bearings are a common element in machines. Because the transverse vibration of externally pressurized gas bearings exhibits damping only over a narrow frequency band, gas bearings are reputed to be poorly damped. In addition, no systematic design procedure for the frequency-dependent damping is available. This work accurately predicts the dynamic stiffness of gas bearings over a broad frequency range, and shows that externally pressurized gas bearings can exhibit significant damping when properly designed.

7638 (YJT—84-18) Fabrication of canisters for final disposal of spent nuclear fuel in Finland. Aaltonen, P.; Haenninen, H. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Apr 1984. 30p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. File Number DE86700223.

Development of fabrication technology of canisters for direct disposal of irradiated nuclear fuel in a deep geologic vault is described. Two design concepts are being studied, one in which the container shell supports the service stresses (Cu-canister), and one in which an internal medium provides support for the outer shell (Ti-canister). Some design details for various canisters are described, together with the fabrication and testing programs that are planned. The possibilities of Finnish metal industry to fabricate the canisters are discussed.

7639 Water displacement mercury pump. Nielsen, M. G. (to United States of America as represented by the United States Department of Energy). US Patent 4,534,709. 13 Aug 1985. Filed date 20 Apr 1984. vp.

PAT-APPL-602243.

A water displacement mercury pump has a fluid inlet conduit and diffuser, a valve, a pressure cannister, and a fluid outlet conduit. The valve has a valve head which seats in an opening in the cannister. The entire assembly is readily insertable into a process vessel which produces mercury as a product. As the mercury settles, it flows into the opening in the cannister displacing lighter material. When the valve is in a closed position, the pressure cannister is sealed except for the fluid inlet conduit and the fluid outlet conduit. Introduction of a lighter fluid into the cannister will act to displace a heavier fluid from the cannister via the fluid outlet conduit. The entire pump assembly penetrates only a top wall of the process vessel, and not the sides or the bottom wall of the process vessel. This insures a leakproof environment and is especially suitable for processing of hazardous materials.

7640 Optimization of Nb_3Sn. Suenaga, M. (Division of Metallurgy and Materials Science, Brookhaven National Laboratory, Upton, New York). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **MAG 21**: No. 2, 1122-1128(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

Considerable progress has been made in the fabrication of large quantities of Nb_3Sn multifilamenta wires, and a number of small and large magnets have been produced successfully using these wires. However, demands for increased critical-current densities J/sub c/ in the medium magnetic field range (8-12 T) as well as at very high fields (16-20 T or greater) are now being made in order to reduce the cost and to increase the efficiencies of large machines (fusion reactors and high-energy particle accelerators). In order to help meet these demands, some improvements have recently been made in increasing J/sub c/ of Nb_3Sn, e.g., Ti additions to Nb_3Sn. In this presentation, the characterization of Nb_3Sn for physical properties (resistivity, lattice parameter, chemical compositions at the grain boundaries and in the bulk, etc.) and for microstructural and chemical properties are reviewed and those properties which are particularly important in producing high values of J/sub c/ are discussed.

7641 A one-phase dual converter for two quadrant power control of superconducting magnets. Ehsani, M.; Boom, R.W.; Kustom, R.L. (Electrical Engineering, Texas A & M University, College Station, TX). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **MAG 21**: No. 2, 1115-1118(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

This paper presents the results of theoretical and experimental development of a new dc-ac-dc converter for superconducting magnet power supplies. The basic operating principles of the circuit are described followed by a theoretical treatment of the dynamics and control of the system. The successful results of the first experimental operation and control of such a circuit are presented and discussed.

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REFER ALSO TO CITATION(S) 7706, 8059, 8102

7642 (CONF-850956—8) Coherent short wave radiation from a solid state free electron laser. Bogacz, S.A.; Ketterson, J.B.; Wong, G.K. (Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy; Argonne National Lab., IL (USA)). Sep 1985. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003055.

From 7. international free-electron laser conference; Tahoe City, CA, USA (8 Sep 1985).

The idea of using a crystal lattice or a superlattice as an undulator for a free electron laser is explored. A purely classical treatment of relativistic positrons channeling through the proposed structure is performed in a self consistent fashion involving the wave equation for the radiating electromagnetic field and the kinetic equation for the positron distribution function. The gain coefficient for a forward radiating field is obtained in closed analytic form and is studied numerically for a (110) planar channeling in Si. This result, combined with a feedback mechanism arising from Bragg diffraction within the basic crystal lattice, may lead to an instability of the radiation inside the crystal.

7643 (DOE/ER/45158—2) Experimental and theoretical studies on transport processes in laser welding. Progress report. DebRoy, T. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). Oct 1985. Contract FG02-84ER45158. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002953.

Although lasers are utilized for various materials processing applications, laser welding is not an acceptable procedure for certain alloys. If an alloy contains one or more volatile components, selective vaporization of relatively more volatile components during laser welding may lead to inadequate control of the weld composition and poor mecahnical properties of the fabricated product. The loss of alloying elements and the eventual properties of the weld zone are influenced by fluid flow in the weld pool, heat transfer and the thermodynamics and the kinetics of the vaporization of various components from the molten pool. In order to understand and eventually control the alloying element loss from the laser melted pool an experimental and theoretical program of studies was initiated at Penn State in August 1984. This report documents the progress made to date on this grant.

7644 (LA-UR—85-3166) Three-dimensional simulations of free-electron laser physics. McVey, B.D. (Los Alamos National Lab., NM (USA)). Sep 1985. Contract W-7405-ENG-36. 23p. (CONF-850956—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000782.

From 7. international free-electron laser conference; Tahoe City, CA, USA (8 Sep 1985).

A computer code has been developed to simulate three-dimensional free-electron laser physics. A mathematical formulation of the FEL equations is presented, and the numerical solution of the problem is described. Sample results from the computer code are discussed. 23 refs., 6 figs., 2 tabs.

7645 (LA-UR—85-3471) Damage resistance of coated optics. Wadt, W.R. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 21p. (CONF-850476—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002391.

From Symposium on lasers and particle beams for fusion and strategic defense; Rochester, NY, USA (18 Apr 1985).

Successful application of high energy lasers to national needs in strategic defense, inertial confinement fusion and isotope separation is contingent on the development of optical coatings that can withstand very intense radiation. Significant progress has been made in the development of damage resistant coatings over the past 15 years to support the needs of the inertial confinement fusion and isotope separation programs. However, the requirements evolving from the Strategic Defense Initiative (SDI) are much more severe and demand dramatic improvements in the performance of optical coatings beyond the current state of the art. The approach taken at Los Alamos towards solving the problems of optical coatings for SDI is presented.

7646 **(LA-UR—85-3560) Recent advances in ultraviolet laser technology.** Figueira, J.F.; Foltyn, S.R.; Rosocha, L.A.; Sze, R.C.; Tallman, C.R.; Telle, J.; Watkins, D.E. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 16p. (CONF-8509105—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002404.

From 2. Bucharest international conference on trends in quantum mechanics; Bucharest, Romania (2 Sep 1985).

The science and technology of violet and ultraviolet lasers has matured rapidly in the last five years. High average power lasers have been demonstrated and several commercial product lines are now available. Single pulse devices have successfully demonstrated large output energies in well controlled beams. In this presentation we will review some of the current laser development programs in progress at Los Alamos. We will describe research in both discharge pumped lasers and E-beam pumped lasers and we will review methods of wavelength conversion in these devices. Finally we will discuss the current understanding of laser induced damage to optical components in the uv.

7647 **(LA-UR—85-3734) High precision damage-resistant multiple-pass ultraviolet reflectometer.** Jolin, L.J.; Foltyn, S.R. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 9p. (CONF-8410186—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002443.

From Symposium on optical materials for high power lasers; Boulder, CO, USA (15 Oct 1984).

A multiple-pass cell was reported by John White in 1942. Since them, it has been adapted for use as a high-precision reflectometer. The multiple-pass reflectometer has been studied and reported by Arnon and Baumeister. Here, a reflectometer which is similar is described. It utilizes a uv laser operating at $\lambda = 351$ nm as the source and the White-cell mirrors are high-reflection dielectric coatings designed for that wavelength. Because of the low-loss reflectors used in the cell, a high number of traversals, reflections, can be achieved; $R \geqq 239$. The use of dielectric mirrors also improves the damage resistance of the apparatus which is important when a uv laser beam is used. The results of reflectance measurements performed on several ultraviolet high reflectors are also reported. These include conventional dielectric coatings as well as a hybrid coating consisting of Al_2O_3, HfO_2, and SiO_2 layers. The Los Alamos optical damage laboratory has observed and defined several types of laser-induced damage to optical materials. In the case of high reflection, multi-layer, dielectric coatings, damage may be defined as any change in the coating layers or at the substrate interface which causes a measurable change in reflectance at its design wavelength. Since most dielectric high reflectors have reflectances approaching unity, and a change caused by laser irradiation can be minute, a precise method for measuring high reflectance must be utilized. A multiple-pass reflectometer based on the White cell was selected because of its demonstratd precision and high accuracy. It utilizes a laser as the source for reasons described later.

7648 **(LA-UR—85-3785) Ion beam characterization of multi-layer dielectric reflectors.** Beery, J.G.; Hollander, M.G.; Maggiore, C.J.; Redondo, A.; Westervelt, R.T.; Taylor, T.N. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 8p. (CONF-851052—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003689.

From 17. annual symposium on optical materials for high-power lasers; Boulder, CO, USA (28 Oct 1985).

Energetic ion beams were used to characterize multilayer dielectric reflectors. Alpha-particle beams with beam spot sizes between 10 microns and a few millimeters were scattered from reflectors consisting of 32-layer SiO_2/HfO_2 and 38-layer MgF_2/ThF_4. The RBS spectra reveal the nature of the laser damage processes by providing information on diffusion, mixing, and loss of material in the coatings. The particle-induced x-ray emission (PIXE) technique gave complimentary results on low-concentration impurities in the coatings.

7649 **(LA-UR—85-3854) Optical beam bending and focusing in free-electron oscillators.** Warren, R.W. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 18p. (CONF-850956—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002426.

From 7. international free-electron laser conference; Tahoe City, CA, USA (8 Sep 1985).

As the bunched electron beam in the wiggler of an FEL oscillates from side to side, it generates a new optical field. This new field is coherent with the "old" field that entered the wiggler and bears a phase relationship to that field depends upon many variables. If the new field is in phase with the old, optical gain occurs. If it is 90^0 out of phase, the combined fields have a phase shift that represents retardation, that is, a real positive index of refraction. This phase shift generally does not occur uniformly over the cross section of the optical beam, but is concentrated in the center for an aligned system or to one side for a misaligned system. The former case leads to optical beam focusing, the latter to beam bending along with the focusing. An FEL oscillator can be a particularly sensitive arrangement for observing focusing and bending because of the abrupt termination of the macropulse of electrons. This termination triggers a transverse oscillation of the optical pulse that is trapped in the cavity around its equilibrium position. The amplitude of the oscillation can be large. During the Los Alamos oscillator experiment, we observed the bending phenomenon. In this paper we present the results of these observations, a discussion of different models that might be used to explain them, and a comparison of the measurements with crude calculations using our final model.

7650 **(LA-UR—85-3864) Symposium welcome and perception of future research.** Newnam, B.E. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-8410276—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002422.

From Boulder damage symposium; Boulder, CO, USA (15 Oct 1984).

7651 **(LA-UR—85-4071) Status of the Los Alamos Free-Electron Laser.** Watson, J.M. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 9p. (CONF-850956—15). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003656.

From 7. international free-electron laser conference; Tahoe City, CA, USA (8 Sep 1985).

Since the initial oscillator experiments were completed last year, the Los Alamos FEL has undergone some major modifications and additions in preparation for the next set of experiments. The laser performance is projected to be substantially enhanced, the rf energy-recovery technique will be demonstrated, and FEL physics measurements will be expanded. The accelerator is now being tuned with very promising performance. The above experiments will be completed during the next year.

7652 **(LBL—19939) Steady-state FEL: particle dynamics in the FEL portion of a two-beam accelerator.** Sternbach, E.; Sessler, A.M. (Lawrence Berkeley Lab., CA (USA)). Sep 1985. Contract AC03-76SF00098. 37p. (CONF-850956—10). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86002866.

From 7. international free-electron laser conference; Tahoe City, CA, USA (8 Sep 1985).

Motivated by its use in a Two-Beam Accelerator, we have studied a "steady-state" FEL; i.e., a periodic but very long structure in which the electron beam energy is replenished once a period with a short induction acceleration unit. We have studied longitudinal particle motion in such a device using a 1-D simulation code. We show that after an initial start-up section, particle detrapping from the pondermotive wave is minimal in a steady-state FEL

of several kilometers. A simple linear model of particle diffusion is shown to describe the numerical results quite well.

7653 (UCRL—90805) Laser beam diagnostics for metal working applications. Ramos, T.J.; Lingenfelter, R.C. (Lawrence Livermore National Lab., CA (USA)). 1984. Contract W-7405-ENG-48. 9p. (CONF-8411100—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002601.

From International conference on applied lasers and electro optics; Boston, MA, USA (12 Nov 1984).

The Materials Fabrication Division (MFD) of Lawrence Livermore National Laboratory (LLNL) has three pulsed Nd-YAG lasers dedicated to metal working. The units are used for welding, brazing, cutting, and drilling. The MFD facility is a job shop fabricating prototypes of design concepts. For the most part these fabrications represent one-of-a-kind parts. When a design does prove successful, we are required to produce additional units for testing. We have found that by following a standard setup procedure in our initial fabrication, carefully measuring the significant parameters, and maintaining a thorough record of these data, we can reproduce desired results in subsequent parts with a minimum of setup time. Careful control of all operating parameters is essential; however, the control of the mode of the laser beam, the stability of the mode, and the symmetry of the laser beam is the key to reproducible results. This paper will review the procedure used for set up and operation of the laser metal working systems, with particular emphasis on the methods used to define and control the mode, stability and symmetry of the laser beam.

7654 (UCRL—93463) Low-cost laser diagnostic system. Ramos, T.J.; Lim, D.R.; Lingenfelter, A.C. (Lawrence Livermore National Lab., CA (USA)). 7 Oct 1985. Contract W-7405-ENG-48. 20p. (CONF-8511103—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002370.

From ICALEO international congress on the applications of lasers and electro-optics; San Francisco, CA, USA (11 Nov 1985).

The principal feature of a new laser diagnostic system is real-time display of beam energy profile. This ensures on-line verification of beam mode and stability with capability for computer storage of this information for later analysis. This system provides low-cost control and repeatability, essential in precision metalworking operations.

7655 Measurement of population inversions and gain in carbon fiber plasmas. Milchberg, H.; Skinner, C.H.; Suckewer, S.; Voorhees, D. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Applied Physics Letters;* **47**: No. 11, 1151-1153(1 Dec 1985).

A CO_2 laser (~0.5 kJ energy, 50—80 ns pulse width) was focused onto the end of an axially oriented, thick (35—350 μ) carbon fiber with or without a magnetic field present along the laser-fiber axis. We present evidence for axial-to-transverse enhancement of the C VI 182 A (n = 3—2) transition, which is correlated with the appearance of a population inversion between levels n = 3 and 2. For the B = 0 kG, zero field case, the maximum gain length product of klroughly-equal3 (kroughly-equal6 cm^{-1}) was measured for a carbon fiber coated with a thin layer of aluminum (for additional radiation cooling). The results are interpreted in terms of fast recombination due mostly to thermal conduction from the plasma to the cold fiber core.

7656 LiF:F_2i color center laser with narrowband high-power pulsed output. Brundage, R.T.; Yen, W.M. (University of Wisconsin-Madison, Physics Department, Madison, Wisconsin 53706). *Applied Optics;* **24**: No. 22, 3687-3689(15 Nov 1985). Contract AC02-83ER45023.

A high-power pulsed color center laser using LiF:F_2^+ centers is designed which exhibits stable operation from 860 to 1000 nm. (AIP)

7657 Stimulated rotational Raman scattering in nitrogen in long air paths. Henesian, M.A.; Swift, C.D.; Murray, J.R. (Lawrence Livermore National Laboratory, University of California, P.O. Box 5508, Livermore, California 94550). *Optics Letters;* **10**: No. 11, 565-567(Nov 1985). Contract W-7405-ENG-48.

We studied the growth from amplified spontaneous emission of stimulated Raman scattering in air using a 20-cm-diameter, linearly polarized, 1053-nm laser beam propagating over a 20-150-m air path. For 2.5-nsec square pulses we found about 1% conversion on the S(8) and S(10) rotational Raman lines of nitrogen at an intensity—length product of 12 TW/cm, which implies a small-signal gain coefficient of 2.5 cm/TW. For 1-nsec square pulses, 1% conversion requires an intensity—length product of about 16 TW/cm. The beam quality deteriorates severely above Raman threshold.

7658 Soft X-ray laser experiments at the Novette laser facility. Matthews, D.; Hagelstein, P.; Rosen, M.; Kauffman, R.; Lee, R.; Wang, C.; Medecki, H.; Campbell, M.; Ceglio, N.; Leipelt, G. (Lawrence Livermore National Laboratory, Livermore, California 94550). *AIP (American Institute of Physics) Conference Proceedings;* **119**: No. 1, 25-44(1 Sep 1984). Contract W-7405-ENG-48.

We discuss the results of and future plans for experiments to study the possibility of producing an x-ray laser. The schemes we have investigated are all pumped by the Novette Laser, operated at short pulse (tau/sub L/~100 psec) and an incident wavelength of λ/sub L/~0.53 μm. We have studied the possibility of lasing at 53.6, 68.0-72.0, 119.0, and 153.0 eV, using the inversion methods of resonant photo-excitation, collisional excitation, and three-body recombination.

7659 XUV/VUV free-electron laser oscillator. Goldstein, J.C.; Newman, B.E.; Cooper, R.K.; Comly J.C. Jr. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **119**: No. 1, 293-303(1 Sep 1984).

It is shown, from computations based on a detailed theoretical model, that modest improvements in electron beam and optical mirror technologies will enable a free-electron laser, given by an rf linear accelerator operate in the 50—200-mn range of optical wavelengths.

7660 Diagnostics for an for an XUV/soft x-ray laser. Kauffman, R.L.; Matthews, D.L.; Ceglio, N.; Medecki, H. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **119**: No. 1, 330-336(1 Sep 1984).

We have begun investigating the production of an XUV/soft x-ray laser, using our high-powered glass lasers as drivers. A major diagnostic for lasing is the measure of the absolute power produced in the lasing line. I have developed a spectrography to time-resolve lasing lines in the energy range from 50 eV to greater than 200 eV. The spectrograph combines a transmission grating and x-ray streak camera to produce a flat field in the energy range from 50 eV to greater than 200 eV. The spectrograph combines a transmission grating and x-ray streak camera to produce a flat field instrument. A cylindrical mirror is used in front of the grating to image the source and act as a collecting optic. The efficiency of the components is calibrated so that absolute intensities can be measured. I will compare the performance of this instrument with reflection grating systems. I will also discuss planned improvements to the system which should increase total throughput, image quality, and resolving power.

7661 Excitation of metastable extreme ultraviolet levels. Caro, R.G.; Wang, J.C.; Young, J.F.; Harris, S.E. (Edward L. Ginzton Laboratory, Stanford University, Stanford, California 94305). *AIP (American Institute of Physics) Conference Proceedings;* **119**: No. 1, 417-426(1 Sep 1984).

The excitation of large densities of high energy metastable atoms and ions is described. Ionic metastable levels are produced as a result of photoionization by x-rays emitted from a laser-produced plasma. For the case of metastable levels in neutral atomic species, excitation is caused by a "photoionization electron source." The electrons involved in this excitation are created when an "absorber" gas is photoionized by a burst of laser-produced x-rays.

4204 HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 6922, 6939

7662 **(DOE/ER/12049—1) [Criteria for the reliability of numerical approximations to the solution of fluid flow problems]. Final technical report.** (Indiana Univ. Foundation, Bloomington (USA)). 6 Dec 1985. Contract AC02-82ER12049. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003970.

The numerical approximation of the solutions of fluid flows models is a difficult problem in many cases of energy research. In all numerical methods implementable on digital computers, a basic question is if the number N of elements (Galerkin modes, finite-difference cells, finite-elements, etc.) is sufficient to describe the long time behavior of the exact solutions. It was shown using several approaches that some of the estimates based on physical intuition of N are rigorously valid under very general conditions and follow directly from the mathematical theory of the Navier-Stokes equations. Among the mathematical approaches to these estimates, the most promising consists in giving upper estimates to the fractal dimension of the attractor associated to one (or all) solution(s) of the respective partial differential equations.

7663 **(DOE/PC/40804—T15) Effect of solids circulation on heat transfer from an immersed horizontal rod in a gas fluidized bed.** Iwashko, M.A. (Illinois Univ., Urbana (USA). Dept. of Mechanical Engineering). 1985. Contract FG22-81PC40804. 75p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86003646.

Thesis.

The influence of solids motion on heat transfer to immersed surfaces within fluidized beds has been well established, yet details of the relationship remain unclear. Although some general trends have been observed in the variation of the local heat transfer coefficient around the circumference of an immersed horizontal tube, few attempts have been made toward describing the effect of the gross solids circulation on the values of the heat transfer coefficients for heat exchange surfaces distributed throughout the bed volume. This can be attributed to the inability of previous researchers to measure the solids velocity distribution within the fluidized bed. The present study utilizes a novel particle tracking method to measure mean solids velocities and to observe the effect of solids motion on heat transfer to immersed surfaces within the bed. The gross circulation patterns are presented for monodispersed particles with a mean diameter of 0.50 mm at a fluidizing velocity of 2.5 times the minimum. The variation of the local heat transfer coefficient around the circumference of an immersed horizontal rod was measured at four bed locations and at three fluidizing velocities including 2.5 times the minimum. It was found that the magnitudes of the heat transfer coefficients were greatly influenced by the direction of solids flow. The coefficients were highest at those locations where solids impact was greatest.

7664 **(DOE/PC/40804—T16) Particle-tracking studies for solids motion in a gas fluidized bed.** Lin, J. (Illinois Univ., Urbana (USA). Dept. of Mechanical Engineering). 1981. Contract FG22-81PC40804. 193p. NTIS, PC A09/MF A01; GPO Dep. File Number DE86003643.

Thesis.

It is known that solids motion plays important roles in heat and mass transfer in fluidized beds. The lack of techniques for systematic, quantitative exploration of the solids velocities has seriously hampered the fundamental understanding of transport processes in a fluidized bed. The present study concerns the development of a technique, based on radioactive particle tracking, to study the solids motion in fluidized beds. The principle, design and fabrication of the facility are described in detail in this dissertation. Data reduction schemes are also presented. The mean velocity distributions of solids, ranging from 0.42 to 0.8 mm, fluidized by air flows, ranging from 1.65 to 4.6 times the minimum fluidizing velocity, are presented. It was found that the patterns of gross solids circulation were heavily dependent on the fluidizing velocity and particles size. Sample measurements of limited range of conditions were also obtained for a bed with a distributor plate smaller than the bed cross section and for a bed with a spherical internal structure. In addition, several exploratory studies were also conducted. Sample results of the Lagrangian auto-correlation and turbulent shear stress of the fluctuating velocities are presented. Furthermore, by superimposing selected sets of the tracer's location data to "synthesize" the stratified bed experiments, a picture of the solids mixing was obtained. The results suggest that they are feasible and could be valuable in furthering the understanding of fluidized bed dynamics. 46 refs., figs., tabs.

7665 **(PNL—5372) Turbulence and energy conversion research.** Hutchinson, R.A. (Pacific Northwest Labs., Richland, WA (USA)). Jul 1985. Contract AC06-76RL01830. 47p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85015232.

This report examines the role of fluid mechanics research (particularly turbulence research) in improving energy conversion systems. In this report two of the listed application areas are selected as examples: fluidization and cavitation. Research needs in general, and research possibilities for ECUT in particular, are examined.

7666 **Exchange factor method: An alternative basis for zonal analysis of radiating enclosures.** Larson, M.E.; Howell, J.R. (Fluid Mechanics and Heat Transfer Division 1513, Sandia National Laboratories, Albuquerque, NM 87185). *Journal of Heat Transfer;* **107**: No. 4, 936-942(Nov 1985).

In zonal analysis of an enclosure containing a radiatively participating medium, the volume and bounding surface are divided into volume and area elements which are assumed to be isothermal. For a system of M elements consisting of N surfaces and Γ volume elements ($M = N+\Gamma$), M^2 relationships (direct- or total-exchange areas of conventional zonal analysis) define all possible radiant interchange between element pairs. Due to reciprocity there are at most $M(M+1)/2$ unique direct-exchange areas. The use of symmetry may greatly reduce the number of unique exchange areas. In the alternative form presented, exchange factors are defined such that a gray medium's gas-to-gas exchange factors describe only the redistribution of radiative source terms. Only surface-to-surface and surface-to-gas (gas-to-surface) relationships are required to wholly define the system in radiative equilibrium. That is, a system in radiative equilibrium may be characterized by as many as $\Gamma(\Gamma+1)/2$ fewer factors. These same exchange factors may be augmented by gas-to-gas exchange factors to analyze media not in radiative equilibrium. In an isotropically scattering, gray medium, exchange factors are functions of system geometry and total extinction only. The degree of extinction due to scattering does not affect exchange factor. Transformations between direct-exchange areas and exchange factors are developed.

4205 MATERIALS TESTING

REFER ALSO TO CITATION(S) 7446

7667 **(BDX—613-3413) Applications of dry contact ultrasonic transducers.** Brunk, J.A. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Nov 1985. Contract AC04-76DP00613. 9p. (CONF-851151—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003133.

From 11. world conference on nondestructive testing; Las Vegas, NV, USA (3 Nov 1985).

Three types of dry contact ultrasonic transducers are studied to eliminate the problems of liquid couplant transducers. The dry contact transducers were found to be advantageous for a variety of testing situations. (BCS)

7668 **(CONF-851115—36) Decoupling of uranium metal with borated plaster using ^{252}Cf nose analysis methods.** Mihalczo, J.T.; King, W.T.; Blakeman, E.D. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002451.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The use of borated plaster to isolate uranium (93.2 wt % ^{235}U) metal was studied in a series of subcritical experiments with

uranium metal cylinders (7.0 in. diam, 2.0 in. thick) and slabs (~1.4 x ~5.4 x ~10.1 in. dimensions). In the cylindrical experiments, the thickness of borated plaster was varied up to 10 in. and the subcriticality measured using the ^{252}Cf-source-driven neutron noise analysis method. In the experiments with the uranium slabs, an array of slabs 3 wide and 8 high was assembled in steps to demonstrate the subcriticality of this array with 3.75-in.-thick borated plaster as an isolating material between all uranium slabs. In the slab experiments, both noise analysis and source neutron multiplication measurements were performed. Before assembly of the slab array the presence of boron in the plaster was verified by neutron transmission and gamma-ray spectrometry measurements.

7669 **(EGG-M—09385) Numerical calculations of ultrasonic field/crack interactions.** Johnson, J.A.; Tow, D.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 8p. (CONF-8506110—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003230.

From Review of progress in quantitative NDE; Williamsburg, VA, USA (23 Jun 1985).

A program for calculating realistic ultrasonic fields in solids has been shown to be in good agreement with the model of Thompson and Gray. The program has been used in combination with some simple field/flaw interaction models to predict the spectra of the returning echoes from the flaws, and these spectra have been compared to experimental measurements, with fair agreement for the best model. However, some details of the spectra have only been partially reproduced, indicating that some improvement in the field/flaw interaction models is required.

7670 **(GKSS—85/E/16) Application of the dc potential drop and the partial unloading methods to fracture mechanics tests.** Heerens, J.; Schwalbe, K.H.; Hellmann, D.; Knaack, J.; Mueller-Roos, J. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofftechnologie). 1985. 45p. (CONF-830426—3). NTIS (US Sales Only), PC A03/MF A01. File Number DE86900298.

From ASTM symposium on chevron-notched specimens testing and stress analysis; Louisville, KY, USA (21 Apr 1983).

The ability of the dc potential drop method and the partial unloading technique to measure crack growth and to detect initiation of crack growth has been investigated using a number of steels and aluminium alloys. It was found that within the range of parameters investigated both of these methods can be recommended for the determination of the R-curve; however, since at small amounts of crack growth dc potential drop method gave more consistent results it is therefore considered to be superior. The initiation values J_0 of J determined by fractography were compared with J/sub Ic/ as obtained by current practice. It was found that J/sub Ic/ is poorly related to initiation or to a specific amount of crack growth. A modification of the J/sub Ic/ procedure is proposed. Two contacting arrangements of the dc potential drop method were checked for initiation detection: one indicated initiation by a potential minimum (related to a J value J/sub min/), the other by the intersection of the R-curve with the blunting line (related to a J value J/sub int/).

7671 **(SAND—84-1545) Impact fragmentation of lead and uranium plates.** Grady, D.E.; Bergstresser, T.K.; Taylor, J.M. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1985. Contract AC04-76DP00789. 73p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86003444.

A series of high-velocity impact experiments on lead and uranium plates has been performed in support of the Plutonium Dispersal Studies Program (PDSP). The test geometry and loading conditions were selected to create a diverging hydrodynamic flow and fragmentation process approximating the environment occurring within the hydrodynamic and prompt fragmentation phase of an accidental weapon detonation. The objectives of the experiments were to provide verification for the hydrodynamic computational model and fragmentation theory currently used in PDSP. High-speed photograph and x-ray methods provided time-resolved records of the fragment debris. Image processing was used to analyze the statistical fragment size data. The fragment size data supported the fragmentation theory, although it was necessary to extend fracture energy concepts to include plastic and viscous work as well as surface energy. The strain rate parameter important to the fragmentation theory has been generalized to arbitrary flow fields. A preliminary study of fragmentation theory has been performed. Supporting hydrodynamic calculations are in good agreement with features measured in the test series. Exploratory aerosol measurements are described.

7672 **(CE-Trans—7618) Theoretical and experimental study of the effect of the coupling layer on the response of a wide band ultrasonic transducer.** Perdrix, M.; Baboux, J.C.; Lakestani, F. Translated from *Journal of Physics, D (London). Applied Physics ;* 13: 185-194(1980). 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86900151.

In order to measure the amplitude of an ultrasonic wave propagating in a solid medium, we generally use a piezo-electric transducer in contact with the solid medium via a coupling liquid which provides the acoustic link. This link, and therefore, the measurement of the ultrasonic wave, depends to a great extent on the type, thickness and parallelism of the coupling layer. A number of studies on the effect of the thickness of the coupling liquid have been carried out using a long train of sinusoidal waves (Canella, 1974, Krautkraemer, 1977). We propose, in this paper, to determine the response of a wide band receiving transducer, as a function of its coupling with an aluminium plate with a plane ultrasonic wave propagating in a direction perpendicular to the surfaces of the plate. The pressure wave takes the form of a rectangular pulse with a steeply rising front, enabling measurements to be made between 1 and 20 MHz. The effect of the type, thickness and parallelism of the coupling layer is studied theoretically and experimentally. Finally, we show the experimental results obtained for the pressure wave by measuring the force exerted on the transducer.

7673 **(CE-Trans—7519) Relaxation and brittle behaviour of high-temperature bolted connections.** Erker, A.; Mayer, K.H. Translated from *VGB Kraftwerkstechnik ;* No. 2, 121-131(Feb 1973). 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86900163.

In the design of high-temperature bolted connections special account should be taken of the relaxation and brittle behaviour of the bolt material. As few tests have been conducted, particularly with regard to the long-term behaviour, it was the aim of this paper to investigate these two material properties in the temperature range between 425 and 540°C up to 30,000 h with the high-temperature bolt materials commonly used in steam turbine construction.

4206 SAFETY ENGINEERING

7674 **(EGG-M—10085) Structural performance of the DOE's Idaho National Engineering Laboratory during the 1983 Borak Peak earthquake.** Guenzler, R.C.; Gorman, V.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 11p. (CONF-8510118—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003217.

From DOE's natural phenomena hazards mitigation conference; Las Vegas, NV, USA (7 Oct 1985).

The 1983 Borah Peak Earthquake (7.3 Richter magnitude) was the largest earthquake ever experienced by the DOE's Idaho National Engineering Laboratory (INEL). Reactor and plant facilities are generally located about 90 to 110 km (60 miles) from the epicenter. Several reactors were operating normally at the time of the earthquake. Based on detailed inspections, comparisons of measured accelerations with design levels, and instrumental seismograph information, it was concluded that the 1983 Borah Peak Earthquake created no safety problems for INEL reactors or other facilities. 10 refs., 16 figs., 2 tabs.

4207 VACUUM ENGINEERING

7675 Tent-type bakeout oven. Hess, B.V.; Felter, T.E. (Sandia National Laboratories, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 3: No. 6, 2218-2218(Nov 1985).

A bakeout oven has been designed and built using quartz infrared lamps bring the vacuum system chamber to a bakeout temperature of 200 C in 75 mi nutes. (AIP)

4208 ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 7522, 7725, 7754, 7761, 7778

7676 (DOE/ER/01195—501-1) Advanced cooling techniques for fastbus electronics. Golliher, E.L. (Illinois Univ., Urbana (USA). Dept. of Physics). 1985. Contract AC02-76ER01195. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86002464.

FASTBUS is a standardized, modular, data-bus system for data acquisition, data processing and control. Some of the high energy physics research centers which use FASTBUS include Fermilab in Batavia, Illinois, Brookhaven National Laboratories in New York, and the European Organization for Nuclear Research, CERN, in Geneva, Switzerland. Although numerous other locations throughout the world use FASTBUS, it is from these locations that information was gathered and will be discussed in this report. FASTBUS provides a standardized format for both software and hardware design, such that system users worldwide can exchange information and developments among various high energy physics research locations without encountering incompatibility. Since this report is primarily concerned with the cooling aspects of FASTBUS electronics, only the mechanical hardware design limitations will be discussed. Modular components which are of concern to a cooling system are the crate and electronics boards (known as the Module) inserted into it.

7677 (LA—10466-MS) Progress in radiation immune thermionic integrated circuits. Lynn, D.K.; McCormick, J.B. (comps.). (Los Alamos National Lab., NM (USA)). Aug 1985. Contract W-7405-ENG-36. 149p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86003286.

This report describes the results of a program directed at evaluating the thermionic integrated circuit (TIC) technology for applicability to military systems. Previous programs under the sponsorship of the Department of Energy, Office of Basic Energy Sciences, have developed an initial TIC technology base and demonstrated operation in high-temperature and high-radiation environments. The program described in this report has two parts: (1) a technical portion in which experiments and analyses were conducted to refine perceptions of near-term as well as ultimate performance levels of the TIC technology and (2) an applications portion in which the technical conclusions were to be evaluated against potential military applications. This report draws several conclusions that strongly suggest that (1) useful radiation-hard/high-temperature operable integrated circuits can be developed using the TIC technology; (2) because of their ability to survive and operate in hostile environments, a variety of potential military applications have been projected for this technology; and (3) based on the above two conclusions, an aggressive TIC development program should be initiated to provide the designers of future systems with integrated circuits and devices with the unique features of the TICs.

7678 (ORNL/M—108) Basic studies of gases for fast switches. Annual summary report, October 1, 1984-September 30, 1985. Christophorou, L.G.; Hunter, S.R. (Oak Ridge National Lab., TN (USA)). Nov 1985. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004011.

Desirable electron attachment and electron drift characteristics of gases for possible use in diffuse-discharge switches are indicated. Gas mixtures for possible use in externally sustained (e-beam) diffuse-discharge switches are suggested on the basis of electron attachment rate constants and electron drift velocities measured as a function of the density-normalized electric field E/N. Of particular promise are mixtures of Ar and C_3F_8.

7679 (SAND—85-1077) Transient response of an infinite cylindrical antenna in a dissipative medium. Chen, K.C. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 57p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86004230.

The transient response of an infinite cylindrical antenna in a dissipative medium to an impulse excitation is calculated via an exact solution in the form of definite integrals and a simple, accurate asymptotic formula. The transmission line solution is shown to be a limiting case of the exact solution. By-products of this study include extension of a general asymptotic method to a more complicated integral and evaluation of a new definite integral.

7680 (SAND—85-1761) Failure analysis of 24-pin leaded chip carriers. Cieslak, W.R. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1985. Contract AC04-76DP00789. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004227.

Cracking of the leads of 24-pin leaded chip carriers (Package Part No. 343570, Device No. TA631) has been found to be caused by fatigue during ultrasonic cleaning. The frequency of the cleaner induced resonance that caused the leads to bend; the higher the cleaner's power, the more severe the cracking. The cracks were not readily visible until they had been outlined by corrosion products. Experiments in the laboratory have reproduced the cracking and corrosion observed in parts that had been manufactured over the course of several years.

7681 (UCRL—90983) Net-2 models of cavities and diodes. Vogtlin, G.E. (Lawrence Livermore National Lab., CA (USA)). 21 Sep 1984. Contract W-7405-ENG-48. 12p. (CONF-8410168—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002193.

From 6. Biennial computer use by engineers symposium (CUBE); Los Alamos, NM, USA (10 Oct 1984).

The network analysis program Net-2 has been used to model microwave cavities and wave guides, techniques using both lumped lines and distributed transmission lines have been used with good agreement compared to measured values. This technique is applicable to pill box and rectangular cavities as well as rectangular and circular wave guides. Higher order modes can be modeled in addition to the fundamental mode. Pulse driven diodes have been modeled using Child-Langmuir limited current. These models use six to nine sections to represent the various radial currents, and section parameters. Complex rise times and resonances have been evaluated and measured to several giga hertz.

7682 (UCRL—92947) Sub-200 picosecond GaAs sample-and-hold circuit for a multi-gigasample/second integrated circuit. Swierkowski, S.; Mayeda, K.; Cooper, G.; McConaghy, C. (Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract W-7405-ENG-48. 6p. (CONF-851237—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002598.

From IEEE international electron devices meeting; Washington, DC, USA (1 Dec 1985).

We report initial results on a digital/analog, 1-micron gate GaAs MESFET IC whose purpose is to record with bandwidths exceeding 1 GHz nonrepetitive analog transient waveforms of a few nanoseconds duration. Specialized buffered-fet logic digital circuits with T/sub pd/ as low as 70 psec generate a pulse burst that strobe a series of 20 linear gate sample-and-hold circuits. These 3-gate MESFET sampling circuits have demonstrated sampling apertures of less than 200 psec, without pretriggering required. Backgating effects on the circuit design and performance and high speed techniques are reviewed. Earlier work (1) on this scheme has been extended from 1nsec step inputs to 100 psec and variable biasing in the linear gate circuit has been added.

7683 **Solution of the nonlinear Poisson equation of semiconductor device theory.** Mayergoyz, I.D. (Electrical Engineering Department, University of Maryland, College Park, Maryland 20742). *Journal of Applied Physics;* **59**: No. 1, 195-199(1 Jan 1986). Contract AS05-84ER13145.

A new iterative method for solving the discretized nonlinear Poisson equation of semiconductor device theory is presented. This method has two main advantages. First, it converges for any initial guess (global convergence). Secondly, the values of electric potential are updated at each mesh point by means of explicit formulas (that is, without the solution of simultaneous equations). The first property makes this method quite robust, while the second allows for the implementation of the method on computers with small RAMs. Some numerical results obtained by this method are reported.

7684 **Effects of hydrogen in sealed electrical contacts.** Schubert, R.; Gray, E.W. (Bell Communications Research, Inc., Red Bank, New Jersey 07701-7020). *Journal of Applied Physics;* **58**: No. 11, 4409-4414(1 Dec 1985).

Hydrogen has been an integral atmospheric component of sealed electrical contacts for decades because of its effect on reliability. It is well known that hydrogen is a needed component to prevent high contact resistance due to carbon-spot formation. This hydrogen benefit has been attributed to hydrogenation of hydrocarbons (HC), enhanced volatilization of previously deposited carbon, enhanced catalytic activity, and thermal cooling. By a variety of physical and chemical laboratory techniques, this paper shows that the hydrogen is not itself directly active. However, some of the hydrogen is converted to water during the glass sealing process. It is this water which plays the active role in the process of quenching carbon formation from hydrocarbon impurities and also acts as a diluent of HC's adsorbed on the contact surface and in the arcing volume. This limits the carbon accumulation on the contacts and increases lifetime reliability.

4209 WASTE PROCESSING PLANTS AND EQUIPMENT

7685 **(DOE/R1/10063—T1) [Recycling bottles with sort by color]. Final report.** Karter, P. (Resource Recovery Systems, Inc., Branford, CT (USA)). 1 Sep 1982. Contract FG41-79R110063. 11p. (CT—79-002). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000387.

A prototype bottle recycling machine has been built that automatically sorts bottles by color (flint, green, amber). (DLC)

7686 **(EUR—9905-EN/IT) Concentration of waste cutting oil emulsions from metal machining activities by solar energy.** Porta, P. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 94p. (In English and Italian). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

The project involves using a battery of 80 copper solar collectors to gather heat which is supplied, via heat exchanger, to waste oil emulsions having an initial oil-in-water concentration of between 5% and 15%. This emulsion is in turn recycled through an evaporating tower where the oil concentration is gradually increased, thus sharply reducing the volume and offering the possibility of using the extracted oils as fuel. Particular importance is attached to the present difficulties of disposing of these highly polluting emulsions, in view of the high treatment costs involved (saponification and neutralization of the acid residues) and of the build-up of these wastes in on-site dumps. Features of the plant under consideration are its low operating cost and high degree of reliability, due to the simplicity of the components (pumps, exchangers, evaporation tower, copper solar collectors). The plant is situated within the LMI Fornaci di Barga (Lucca) works and is run by the works utilities staff.

4210 COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 6930, 6931, 6933, 7665

7687 **(DOE/R1/10000—T1) [Wood energy in Vermont]. Final report.** Rich, J.P. (Vermont Wood Energy Corp., Stowe (USA)). 5 Jan 1901. Contract FG41-79R110000. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000393.

The purpose of this project was to construct a fully automatic wood-gas/oil burner for residential use. This report summarizes the accomplishments achieved during the grant period. The result was the construction of 4 semi-automatic units which can be converted to fully automatic status with ease. 1 photograph. (DMC)

4230 MARINE ENGINEERING

7688 **(UCID—20552) EMPRESS II evaluation study.** Breakall, J.; Hudson, H.; Kunz, K.; Spogen, L.; Johnson, W. (Lawrence Livermore National Lab., CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Jul 1985. Contract W-7405-ENG-48. 206p. NTIS, PC A10/MF A01; GPO Dep. File Number DE86003537.

This summary report of LLNL's activities in support of the DNA program to advance the knowledge and practice of ship testing contains three independent sections: (1) computer modeling of EMPRESS II simulator; (2) ship testing methodology; and (3) ship coupling phenomenology experiments. Each section addresses a separate major issue in the development of ship testing. These issues are as follows: (1) determining the critical electromagnetic characteristics of the EMPRESS II simulator; (2) developing a ship testing methodology based on current knowledge of ship coupling phenomenology; and (3) understanding and characterizing ship coupling phenomenology via experiment. The questions raised by each issue have been addressed and are documented in this report in detail.

4240 POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 6919

43 PARTICLE ACCELERATORS

4301 DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 7700, 7715, 7740, 7741

7689 (ORNL—6120, pp 1-21) **Holifield Heavy Ion Research Facility.** Jan 1985. NTIS, PC A13/MF A01. File Number DE85006958.

In Physics Division progress report for period ending September 30, 1984.

Beginning January 19, 1984, the Holifield Facility began its first period of typical operation. Since that time, the division of time between beam available for research, development, maintenance, and tuning was near that projected for a normal year. The three and one-half months prior to January 19 were devoted to (1) a major scheduled maintenance period in which 40 of 54 tandem acceleration tube units were removed, reconditioned, and replaced, and in which several major maintenance tasks were performed on the cyclotron, (2) repair and modification of several tandem accelerator column vacuum related components, and (3) initial conditioning of the tandem accelerator. Following a period of operation for the experimental program and another conditioning period in March, the tandem accelerator was operated with beam at a potential of 22.5 MV, a value which exceeds that achieved both at ORNL and at other laboratories by more than 2 MV. Refinements in the calculations used for determining cyclotron operating parameters have made it possible to increase the extraction radius from 77.5 to 79.2 cm. This seemingly modest change has the impressive effect of reducing power for the main cyclotron magnet at the max-

imum mass-energy product by 20%, resulting in a 15% reduction in total power use for cyclotron operation. The Spin Spectrometer has clearly proven to be the most popular research tool of this year. However, it was recently discovered that nearly half of the 70 NaI crystals have extensive cracks which have caused significant deterioration of the detector parameters. The highlight for the experimental apparatus took place at UNISOR. The long-awaited atomic hyperfine structure spectrometer demonstrated its capability to investigate mass separated nuclei produced in heavy-ion induced reactions.

7690 **Scaling laws for RFQ design procedures.** Wadlinger, E.A. (Los Alamos National Laboratory Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2596-2598(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Scaling laws are relations between accelerator parameters (electric field, rf wavelength etc.) and beam parameters (current, energy, emittance, etc.) that define surfaces of constant accelerator performance in parameter space. These scaling laws can act as guides for designing radio-frequency quadrupoles (RFQs). We derive several scaling relations to show the various tradeoffs involved in choosing RFQ designs and to provide curves to help choose starting points in parameter space for optimizing an RFQ for a particcular requirement. We show that there is a unique scaling curve, at a synchronous particle phase of -90°, that relates the beam current, emittance, particle mass, and space-charge tune depression with the RFQ frequency and maximum vane-tip electric field, provided that we assume equipartitioning and equal longitudinal and transverse tune depressions. This scaling curve indicates the maximum performance limit one can expect at any point in any given RFQ. We show several examples for designing RFQs using this procedure.

7691 **Proposed use of the radio-frequency quadrupole structure to funnel high-current ion beams.** Stokes, R.H.; Minerbo, G.N. (Los Alamos National Laboratory, Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2593-2595(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

In this paper, we describe a new approach to funneling beams that are initially accelerated in two radio-frequency quadrupole (RFQ) accelerators. Instead of discrete optical elements, we propose to funnel within an RFQ structure, so that during the funneling process the beam is always confined by periodic transverse focusing. Beams with high space charge experience irreversible emittance growth when they emerge from a periodic focusing system. To alleviate this problem, in the proposed funneling system it should be possible to maintain the same focusing periodicity as that of the accelerators preceding the funnel. Also, instead of conventional deflection systems, we propose to use the properties of a modified RFQ structure to deflect two parallel beams toward each other and to merge them into a single final beam.

7692 **Analytical methods of electrode design for a relativistic electron gun.** Caporaso, G.J.; Boyd, J.K.; Cole, A.G. (Lawrence Livermore National Laboratory, Livermore, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2605-2607(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The standard paraxial ray equation method for the design of electrodes for an electrostatically focused gun is extended to include relativistic effects and the effects of the beam's azimuthal megnetic field. Solutions for parallel and converging beams are obtained and the predicted currents are compared against those measured on the High Brightness Test Stand.

7693 **Power combiners/dividers for loop pickup and kicker arrays for fnal stochastic cooling rings.** Johnson, J.K.; Nemetz, R. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2171-2173(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The anti-proton accumulator and debuncher at FNAL will use stochastic methods to "cool" the beam. Pairs of quarter-wavelength directional-coupler loops are used to detect and kick the beam. The loops are copper plates which are flush with the upper and lower wall of a rectangular beam pipe. The plates, when surrounded by a properly sized pocket, form a 100-ohm transmission-line directional coupler. As the beam passes, a signal which gives position and time information, is induced in the plates. But, because the signal levels are low (<.5 picowatts per pair), a power combiner (usually several primary combiners feeding a secondary combiner) is used to combine the outputs of many loops. Subsequently, the combined signal is amplified, filtered and then fed into a divider, (that is, a combiner operating in reverse). The divider distributes the signal into a different set of loops which modify (kick) the beam's position. Since the loop couplers are arranged linearly, in arrays of various lengths, combiners also provide a convenient method of reducing the number of vacuum feedthroughs and preamplifiers and their related costs in performance and dollars. In this note we describe various stripline combiner systems that add the outputs of 4, 8, 16 or 32 loops.

7694 **A 1500-MeV fixed-field alternating-gradient synchrotron for a pulsed-spallation neutron source.** Kustom, R.L.; Crosbie, E.A.; Khoe, T.K. (Argonne National Lab., Aryonne, IL). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2672-2674(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Argonne is developing the design for an advanced super pulsed-spallation neutron source called ASPUN that uses a fixed-field alternating-gradient accelerator as the proton source. ASPUN is intended to be the next generation in pulsed spallation neutron sources. The spallation source concept was pioneered at ANL, an effort which has led to the successfully operating Intense Pulsed Neutron Source (IPNS). IPNS uses a 500-MeV rapid cycling synchrotron as the proton source. Beam is extracted at a 30-Hz rate onto a depleted uranium target in 100-nanosecond bunches to produce intense bursts of neutrons for solid state physics experiments. The IPNS accelerator routinely delivers greater than 12 μA of timed-averaged proton current on the uranium target. Newer, more powerful pulsed spallation sources are nearly ready to start operation. The Proton Storage Ring at the Los Alamos National Laboratory is designed to deliver 100-μA at 800 MeV in 12-Hz bursts and the Spallation Neutron Source at the Rutherford-Appleton Laboratory in England is designed to deliver 200-μA at 800 MeV in 50-Hz bursts.

7695 **FASTBUS for the particle accelerator laboratories.** Dawson, W.K.; Costrell, L.; Ikeda, H.; Ponting, P.J.; Walz, H.V. (TRIUMF, Vancouver, British Columbia). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2089-2091(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The FASTBUS modular high speed data acquisition and control system for high energy physics and other applications was described by Costrell and Dawson at the 1983 Particle Accelerator Conference. Both the specification and the implementation of this interlaboratory development have progressed considerably since that time. Because of its many attractive features, FASTBUS is currently in use in several major nuclear and high energy physics laboratories and is also finding application in other areas. The initial impetus for the development of FASTBUS came from the high energy physics community, since demands placed upon data acquisition systems by experiments in high energy physics were clearly beyond the capability of existing systems. The experiments being

planned involved data rates much higher than had previously been encountered and total events were increasing because of improved accelerator technology. These were accompanied by order-of-magnitude increases in the size and complexity of the associated detectors and particularly in the number of detector outputs that had to be expeditiously viewed and processed by the electronics. To meet this need for an extremely fast and versatile system, an interlaboratory effort was launched, resulting in the FASTBUS system.

4302 BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

REFER ALSO TO CITATION(S) 7644, 7652, 7719, 7721, 7734, 7738, 7749

7696 (CONF-850956—12) Beam brightness from a relativistic, field-emission diode with a velvet covered cathode. Bekefi, G.; Shefer, R.E.; Tasker, S.C. (Massachusetts Inst. of Tech., Cambridge (USA)). Aug 1985. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001112.

From 7. international free-electron laser conference; Tahoe City, CA, USA (8 Sep 1985).

The beam emittance and brightness from a mildly relativistic (200 to 400 kV) high current density (0.5 to 3.5kA/cm^2) planar, field emission diode provided with a velvet covered cathode have been studied experimentally as a function of the applied electric field (100 to 600kV/cm). Transverse beam spreading has been measured using a conventional pinhole arrangement followed by a fluorescent screen and open shutter camera. Good turn-on, and a high normalized beam brightness (B/sub n/ = 300kA/cm^2-rad^2) have been observed. The results are compared with those obtained with a graphite cathode. 11 refs., 6 figs.

7697 (UCID—20585) Effect of space charge and magnetic field on the interpretation of beam brightness. Boyd, J.K. (Lawrence Livermore National Lab., CA (USA)). 20 Aug 1985. Contract W-7405-ENG-48. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003498.

Beam brightness has been measured experimentally using collimators and emittance selectors. The acceptance of both of these devices must be known to infer a brightness measurement. A computer code has been written to determine the effect of space charge and magnetic field on the acceptance of these devices. The region of validity of analytic acceptance formulas is investigated.

7698 (UCRL—91956) Numerical simulation of secondary electron orbits near an electron beam propagating in a low pressure gas. Teague, M.R.; Yu, S.S. (Lawrence Livermore National Lab., CA (USA)). 14 Aug 1985. Contract W-7405-ENG-48. 10p. (CONF-850504—296). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001651.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

A numerical simulation has been constructed to obtain a detailed, quantitative estimate of the electromagnetic fields generated in a recently-proposed collective accelerator scheme for electrons. The code treats the secondary electrons by particle simulation and the beam dynamics by a time-dependent envelope model. The simulation gives a fully relativistic description of secondary electrons moving in selfconsistent electromagnetic fields. The calculations are made using coordinates t, x, y, z for the electrons and t, ct-z, r for the axisymmetric electromagnetic fields and currents. Code results showing the axial electric field dependence on the configuration of the ultrashort U.V. laser pulse will be given. 4 refs., 4 figs.

7699 (UCRL—92873) Properties of the accelerator-produced beam. Caporaso, G.J.; Chambers, F.W.; Cole, A.G.; Fawley, W.M.; Struve, K.W. (Lawrence Livermore National Lab., CA (USA)). 11 Oct 1985. Contract W-7405-ENG-48. 19p. (CONF-8506141—14). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002374.

From SDIO/DARPA annual propagation review; Monterey, CA, USA (24 Jun 1985).

Obtaining detailed knowledge of the condition of the electron beam delivered to the experimental tank is of prime importance in the attempt to correlate the propagation data with theory. There are many interesting and unique features of the beam delivered by Advanced Test Accelerator (ATA) to the experimental tank.

7700 Electron trajectories in a combined wiggler and alternating gradient quadrupole field. Wang, T.F.; Cooper, R.K. (Los Alamos National Laboratory, Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2599-2601(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

This paper reports on studies of electron trajectories in a combined wiggler and alternating gradient quadrupole field. The quadrupole field is assumed to vary continuously along the symmetry axis. The linearized equations of electron motion are solved analytically for a plane-polarized wiggler by using the twoscale perturbation method. A comparison with the numerical solution is presented, and the conditions for unstable trajectories are discussed.

7701 Electron beam transport and emittance measurements in a long periodic solenoid channel. McAdoo, J.; Conjnacki, E.; Lawson, J.D.; Loschiaplo, P.; Low, K.; Reiser, M. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2632-2634(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

An electron beam transport experiment utilizing 5 kV electrons in a 200 mA beam passing through 36 solenoid lenses is described. The fraction of the beam transmitted is a function of the lens strengths, the length of the channel, the beam size, and the precision of the aligment. Emittance measurements in the 36-lens channel showed no significant degradation compared to a 12-lens channel.

7702 Relation between field energy and RMS emittance in intense particle beams. Wangler, T.P.; Crandall, K.R.; Mills, R.S.; Reiser, M. (Los Alamos National Laboratory, Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2196-2200(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

An equation is presented for continuous beams with azimuthal symmetry and continuous linear focusing, which expresses a relationship between the rate of change for squared rms emittance and the rate of change for a quantity we call the nonlinear field energy. The nonlinear field energy depends on the shape of the charge distribution and corresponds to the residual field energy possessed by beams with nonuniform charge distributions. The equation can be integrated for the case of an rms matched beam to yield a formula for space-charge-induced emittance growth that we have tested numerically for a variety of initial distributions. The results provide a framework for discussing the scaling of rms emittance growth and an explanation for the well-established lower limit on output emittance.

7703 Transport of high-intensity beams. Reisser, M. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2201-2205(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The transport of high-intensity, high-brightness beams is reviewed. Recent results of theoretical studies and experiments are presented.

7704 **Double beat-wave particle acceleration.** Csonka, P.L. (Brookhaven National Laboratory, Upton, NY). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 4, 1520-1523(Aug 1985).

Described are two mechanisms which make it possible for an accelerated charged particle to stay in phase indefinitely with a moving accelerating potential well set up by electromagnetic radiation in a plasma beat-wave accelerator. The first is a double beat-wave mechanism, in which interference between two beatwaves cancel the fields in the interfering electromagnetic waves and the electron oscillations which would otherwise be set up by those waves. The second is an alternating density mechanism, in which one or each of two beat-waves set up resonant electron oscillations in alternate plasma regions, but not in others.

4303 AUXILIARIES AND COMPONENTS

REFER ALSO TO CITATION(S) 7694, 7753, 7755

7705 **(BNL—37195) Experiments for RHIC: a workshop overview.** Ludlam, T. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 4p. (CONF-8504152—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003636.

From Workshop on experiments for Relativistic Heavy Ion Collider (RHIC); Upton, NY, USA (15 Apr 1985).

A large and growing community of nuclear and high energy physicists is now embarked on a program of experiments with very high energy nuclear beams. The first round of these experiments will take place late in 1986, with fixed target experiments at the Brookhaven AGS and the CERN SPS. These programs, involving about 300 experimental physicists, will begin with relatively light ions ($A \simeq 32$ amu) to explore states of compressed nuclear matter in which high energy density is achieved in an environment of high baryon density. Within 2 to 3 years of this initial effort it will be possible with the Booster synchrotron to extend the mass range of AGS beams to cover essentially the entire periodic table. The next goal is then to reach much higher energies with colliding beams of heavy ions, creating thermodynamic conditions with near-zero baryon number which can be directly compared with QCD calculations, exploring the full panoply of phenomena described by Helmut Satz in his physics perspective.

7706 **(BNL—37242) Use of a miniature Toroidal Grating Monochromator on the FEL Undulator at the NSLS.** Johnson, P.D.; Hulbert, S.L.; Howells, M.R. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003628.

The use of a miniature Toroidal Grating Monochromator is described which we intend to use to monochromatize the radiation from the free electron laser (FEL) Undulator at the NSLS. Some of the properties of Undulators are described with reference to the design of beamlines and review the properties of TGM's. The results of ray tracing a beamline using such a device and estimates of the expected flux are given.

7707 **(FNAL-TM—1359) Status of FASTBUS software in the Computing Department at Fermilab.** Cohen, A.; Gannon, S.; Pordes, R. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1985. Contract AC02-76CH03000. 5p. (CONF-8509189—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002544.

From CERN FASTBUS software workshop; Geneva, Switzerland (23 Sep 1985).

This paper presents the current status of FASTBUS software projects in the Data Acquisition Group at Fermilab. The Computing Department, which includes this group, supports software running under the PDP-11 RT-11, RSX and VAX/VMS operating systems. Fortran callable subroutine libraries are available to access FASTBUS through the IORFI-II, UNIBUS Processor Interface (UPI) and Lecroy 1821 Host Interface. The FASTBUS Diagnostic Language, implemented and supported at the University of Illinois, is used at Fermilab, where it has been converted to run under the VAX/VMS and RSX-11M operating systems. A first version of a FASTBUS database has been implemented which provides data to a program which automatically generates logical addresses and Segment Interconnect route tables.

7708 **(LA-UR—85-3579) Control system for the NBS microtron accelerator.** Martin, E.R.; Trout, R.E.; Wilson, B.L.; Ayres, R.L.; Yoder, N.R. (Los Alamos National Lab., NM (USA); National Bureau of Standards, Washington, DC (USA)). 1985. Contract W-7405-ENG-36. 22p. (CONF-8510194—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002400.

From 2. international workshop on accelerator control systems; Los Alamos, NM, USA (7 Oct 1985).

As various subsystems of the National Bureau of Standards/ Los Alamos racetrack microtron accelerator are being brought online, we are gaining experience with some of the innovations implemented in the control system. Foremost among these are the joystick-based operator controls, the hierarchical distribution of control system intelligence, and the independent secondary stations, permitting sectional stand-alone operation. The result of the distributed database philosophy and parallel data links has been very fast data updates, permitting joystick interaction with system elements. The software development was greatly simplified by using the hardware arbitration of several parallel processors in the Multibus system to split the software tasks into independent modules.

7709 **(NP—6900283) Research activities at the OULNS. Annual report.** (Osaka Univ., Toyonaka (Japan). Lab. of Nuclear Studies). 1981. 179p. NTIS (US Sales Only), PC A09/ MF A01;1. File Number DE86900283.

This is the 1981 annual report on research activities at the OULNS (Osaka University Laboratory of Nuclear Studies). The OULNS is the joint organization of the eight research groups; staffs of the six research groups of the cyclotron group, the Van de Graaff group, the high energy physics group, the mass spectroscopy group, the radiation and neutron physics group and the theoretical nuclear physics group are mostly the faculty and research members of the Department of Physics, and those of the radioisotope group are the faculty and research members of the Department of Chemistry. They hold concurrently the OULNS positions in addition to their proper positions in the Physics or Chemistry Department. The cyclotron group has additional research staffs proper to the OULNS. The accelerator development and instrumentation group is composed exclusively by the OULNS proper staff members. The OULNS has four shops of the electronics shop, the solid state detector shop, the target propagation shop, and the machine shop. It has a common library. This report covers the major research activities associated with the OULNS research works and some research activities by those research groups mentioned above.

7710 (ORNL—6120, pp 120-125) **UNISOR program.** Jan 1985. NTIS, PC A13/MF A01. File Number DE85006958.

In Physics Division progress report for period ending September 30, 1984.

The University Isotope Separator - Oak Ridge is a consortium of eleven academic institutions, Oak Ridge Associated Universities and Oak Ridge National Laboratory. It operates an isotope separator installed on-line to the accelerators within the Holifield Heavy Ion Research Facility. The accounts which follow describe work at the UNISOR facility or work associated with UNISOR research performed principally by investigators outside of the Physics Division. Research and development performed at UNISOR principally by Physics Division staff members are included in the Nuclear Physics section of this report. In addition, theoretical research performed by UNISOR staff and collaborators is included in the Theoretical Physics section.

7711 (ORNL—6120, pp 208-221) **Accelerator-collider study.** Alton, G.D.; Atkins, W.H.; Baktash, C.; Beene, J.R.; Biggerstaff, J.A.; Hudson, E.D.; Jones, C.M.; Juras, R.C.; Lee, I.Y.; Martin, J.A. Jan 1985. NTIS, PC A13/MF A01. File Number DE85006958.

In Physics Division progress report for period ending September 30, 1984.

This section describes a study done for an accelerator facility to be used to accelerate counter-rotation beams of heavy nuclei to kinetic energies of 10 GeV per nucleon and to bring these beams into head-on collision. The extreme conditions occurring in the resulting extended system of hot hadronic matter should result in creation in the laboratory of a qualitatively new form of matter, a quark-gluon plasma. The facility consists of a series of three accelerators optimized for the acceleration of heavy ions. The existing tandem electrostatic accelerator will be used as injector, providing beams of heavy ions ranging from ^{12}C to ^{197}Au at corresponding kinetic energies ranging from 10 MeV/u to 2 MeV/u. This will be followed by a small, room temperature, booster synchrotron with a bending product of 16 Tm. The size of this synchrotron is given by the requirement that all the above heavy ions be completely ionized by passage through a stripper foil after their exit from this accelerator. The third accelerator in sequence will be a pair of superconducting accelerator-collider rings. These will intersect at six points and have a bending product of 90.5 Tm, corresponding to 10 GeV/u for $^{197}Au^{79+}$ ions. Experimental halls will be located at (initially) four of the six intersection points and will have facilities for various type detectors ranging from single-arm spectrometers to large 4π detector facilities.

7712 **(SAND—85-2371C) Conceptual HERMES III diode designs.** Sanford, T.W.L.; Halbleib, J.A.; Poukey, J.W.; Wright, T.P.; Hasti, D.E.; Ramirez, J.J.; Spence, P.W.; Bailey, V.L. (Sandia National Labs., Albuquerque, NM (USA); Pulse Sciences, Inc., San Leandro, CA (USA)). 1985. Contract AC04-76DP00789. 29p. (CONF-851136—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86002919.

From Meeting of the Plasma Physics Division of the American Physical Society; San Diego, CA, USA (4 Nov 1985).

Hermes III is a 20 MV 500 to 800 kA linear induction accelerator being designed for use as a large-area uniform source of flash γ-rays. Diode designs that can efficiently convert the electrical energy to γ-ray energy and distribute that γ-ray energy uniformly over a large area are needed. Code simulations of coaxial diode designs show that the electron beam at the anode/cathode gap forms a weak pinch resulting in excessive on-axis radiation. Modifications to the anode/cathode structure to reduce this pinch by controlling the radial electric field are discussed. Results of diode simulations using the PIC code MAGIC and the electron/photon transport code CYLTRAN are presented.

7713 **(UCRL—93174) High Brightness Test Stand.** Birx, D.L.; Caporaso, G.J.; Boyd, J.K.; Hawkins, S.A.; Poor, S.E.; Reginato, L.L.; Rogers, D. Jr.; Smith, M.W. (Lawrence Livermore National Lab., CA (USA)). 7 Aug 1985. Contract W-7405-ENG-48. 13p. (CONF-850956—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002372.

From 7. international free-electron laser conference; Tahoe City, CA, USA (8 Sep 1985).

The High Brightness Test Stand is a 2 MeV, $\leqq$ 10 kA electron accelerator module. This accelerator module, designed as an upgrade prototype for the Advanced Test Accelerator (ATA), combines solid state nonlinear magnetic drives with state-of-the-art induction linac technology. The facility serves a dual role, as it not only provides a test bed for this new technology, but is used to develop high brightness electron optics. We will both further describe the accelerator, as well as present some of the preliminary electron optics measurements.

7714 **(UCRL—93456) Numerical determination of injector design for high beam quality.** Boyd, J.K. (Lawrence Livermore National Lab., CA (USA)). 15 Oct 1985. Contract W-7405-ENG-48. 12p. (CONF-850956—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002373.

From 7. international free-electron laser conference; Tahoe City, CA, USA (8 Sep 1985).

The performance of a free electron laser strongly depends on the electron beam quality or brightness. The electron beam is transported into the free electron laser after it has been accelerated to the desired energy. Typically the maximum beam brightness produced by an accelerator is constrained by the beam brightness deliverd by the accelerator injector. Thus it is important to design the accelerator injector to yield the required electron beam brightness. The DPC (Darwin Particle Code) computer code has been written to numerically model accelerator injectors. DPC solves for the transport of a beam from emission through acceleration up to the full energy of the injector. The relativistic force equation is solved to determine particle orbits. Field equations are solved for self consistent electric and magnetic fields in the Darwin approximation. DPC has been used to investigate the beam quality consequences of A-K gap, accelerating stress, electrode configuration and axial magnetic field profile.

7715 **Stochastic beam cooling amplifier system front end components performance characteristics.** Lo, C.C. (Lawrence Berkeley Laboratory, University of California, Berkeley, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2174-2176(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The stochastic beam cooling amplifier front end consists of 180° hybrids, cables, directional couplers, power dividers/combiners and low noise preamplifiers. Most front ends will be operating at near liquid nitrogen (LN) temperature. Components used in the front ends should be able to operate at this temperature satisfactorily. Since the noise performance of the front end is of utmost importance to the beam cooling process, the insertion losses of cables, 180° hybrids, directional couplers and power combiners have been measured at room temperature and near liquid nitrogen temperature. The purpose of this report is to describe and present some measurements and data on the components mentioned, with the exception of the 1-2 and 2-4 GHz preamplifiers, which have been described elsewhere.

7716 **Tevatron extraction microcomputer.** Chapman, L.; Finley, D.A.; Harrison, M.; Merz, W. (Fermi National Accelerator Laboratory; Batavia, IL). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2144-2146(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Extraction in the Fermilab Tevatron is controlled by a multiprocessor Multibus microcomputer system called QXR (Quad eXtraction Regulator). QXR monitors several analog beam signals and controls three sets of power supplies: the "bucker" and "pulse" magnets at a rate of 5760 Hz, and the "QXR" magnets at 720 Hz. QXR supports multiple slow spills (up to a total of 35 seconds) with multiple fast pulses intermixed. It linearizes the slow spill and bucks out the high frequency components. Fast extraction is done by outputting a variable pulse waveform. Closed loop learning techniques are used to improve performance from cycle to cycle for both slow and fast extraction. The system is connected to the Tevatron clock system so that it can track the machine cycle. QXR is also connected to the rest of the Fermilab control system, ACNET. Through ACNET, human operators and central computers can monitor and control extraction through communications with QXR. The controls hardware and software both employ some standard and some specialized components. This paper gives an overview of QXR as a control system; another paper (1) summarizes performance.

7717 **Numerical simulation of an accelerator injector.** Boyd, J.K.; Caporaso, G.J.; Cole, A.G. (Lawrence Livermore National Laboratory, Livermore, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2602-2605(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Accelerator injector designs have been evaluated using two computer codes. The first code self consistently follows relativistic particles in two dimensions. Fields are obtained in the Darwin model which includes inductive effects. This code is used to study cathode emission and acceleration to full injector voltage. The second code transports a fixed segment of a beam along the remainder of the beam line. Using these two codes the effects of electrode configuration on emittance, beam quality and beam transport have been studied.

7718 **New control techniques for extraction of bevalac beams.** Nyman, M.; Chu, W.; Mehlman, B.; Mirer, W.; Oakley, H.; Renner, T.; Stover, G.; Tekawa, M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2177-2179(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Beams of accelerated heavy ions can now be delivered as one-second-long DC pulses with minimal fluctuations in instantaneous flux. Pulse duration can be held constant to within 1% while keeping a high non-varying extraction efficiency which minimizes pulse-to-pulse position shift in the extracted beam. In addition, differing beam intensities over several orders of magnitude can be delivered. Computer adjustment of all measurement and control devices results in linear operation over three orders of magnitude of beam intensity. Control of beam structure is accomplished by a unique combination of dual slope integrators and phase forward "predictive" circuits in the feedback loop.

7719 **A programmable high power beam damper for the Tevatron.** Crisp, J.; Goodwin, R.; Grrig, R.; Johnson, M.; Jones, A.; Kerns, C.; Kerns, Q.; Lucas, P.; Martin, D.; Miller, H. (Fermi National Accelerator Laboratory, Batavia, Illinois). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2147-2149(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

A bunch-by-bunch beam damper has been developed for the Fermilab Tevatron. The system reduces betatron oscillation amplitudes and incorporates some useful machine diagnostics. The device is programmable via look-up tables so the output is an arbitrary function, on a bunch-by-bunch basis, of the beam displacement. We are presently using this feature to measure the betatron tune throughout the acceleration cycle.

7720 **Accelerator physics measurements at the damping ring.** Rivkin, L.; Allen, M.; Bane, K.; Delahaye, J.P.; Fieguth, T.; Hofmann, A.; Hutton, A.; Lee, M.; Linebarger, W.; Wille, K. (SLAC, Stanford University, Stanford, CA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2626-2628(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Besides the optics measurements described elsewhere, machine experiments were done at the SLC damping ring to determine some of its parameters. The synchrotron radiation energy loss which gives the damping rates was measured by observing the RF-voltage dependence of the synchronous phase angle. The emittance was obtained from the synchrotron light monitor, scraper measurements and by extracting the beam through a doublet and measuring its size for different quadrupole settings. Current dependent effects such as parasitic mode losses, head tail instabilities, synchrotron and betatron frequency shifts were measured to estimate the impedance. RF-cavity beam loading and its compensation were also studied and ion collection was investigated. All results agree reasonably well with expectations and indicate no limitations to the design performance.

7721 **Depolarizing 'beat' resonances in the Brookhaven AGS.** Terwilliger, K.M.; Courant, E.D.; Krisch, A.D.; Ratner, L.D. (University of Michigan, Ann Arbor, Michigan). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2635-2637(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

While accelerating polarized protons in the Brookhaven AGS we found a variant of the standard imperfection and intrinsic depolarizing resonances which has some of the properties of both types. Imperfection resonances occur at $G\gamma = k$, when the number of spin precessions per revolution, G gamma, equals a harmonic of the depolarizing field, k. Intrinsic resonances occur at $G\gamma = nP +$ or $- \nu$ /SUB Z/ , when the AGS gradient periodicities, nP, modulate free vertical betatron oscillations to create the sum and difference frequencies. The variant resonance is a beat between nP and an imperfection driven betatron oscillation of periodicity k'. These occur at $G\gamma = nP +$ or $-$ k', and are strongest when the driven betatron oscillation is largest. The effect was most dramatic at the strong $G\gamma = 27$ resonance. Since ν /SUB Z/ = 8.8 for the AGS, and there is a major nP = 36 AGS periodicity, a strong beat resonance should exist at G gamma = 36-9 = 27. Applying a 27 /SUP th/ harmonic correction directly was unsuccessful, but a 9 /SUP th/ harmonic correction removed the depolarization.

7722 **A protable Database driven control system for SPEAR.** Howry, S.; Gromme, T.; King, A.; Sullenberger, M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2104-2106(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The new computer control system software for SPEAR is presented as a transfer from the PEP system. Features of the target ring (SPEAR) such as symmetries, magnet groupings, etc., are all contained in a design file which is read by both people and computer. People use it as documentation; a program reads it to generate the database structure, which becomes the center of communication for all the software. Geometric information, such as element positions and lengths, and CAMAC I/O routing information is entered into the database as it is developed. Since application processes refer only to the database and since they do so only in generic terms, almost all of this software (representing more then fifteen man years) is transferred with few changes. Operator console menus (touchpanels) are also transferred with only superficial changes for the same reasons. The system is modular: the CAMAC I/O software is all in one process; the menu control software is a process; the ring optics model and the orbit model are separate processes, each of which runs concurrently with about 15 others in the multiprogramming environment of the VAX/VMS operating system.

7723 **Hardware upgrade for klystrons in the SLC.** Jobe, R.K.; Browne, M.J.; Slattery, K.P. (Stanford Linear Accelerator Center, Stanford University, Stanford, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2107-2109(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The control and monitoring of the klystrons in the first third of the SLAC linear accelerator has been commissioned, and a program to complete installation by summer 1985 is in progress. A general overview of the new control system for SLAC klystrons is presented along with a detailed description of the Modulator Klystron Support Unit. The MKSU contains all the devices necessary to interface klystron monitoring and control to the SLC control system through a dedicated intelligent CAMAC module. Controlled devices include RF phase and drive controls, the high power modulator status, associated RF signals, waterflow and magnet controls.

7724 **Klystron control software in the SLC.** Jobe, R.K.; Phinney, N.; Thompson, K. (Stanford Linear Accelerator Center, Stanford University, Stanford, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2110-2111(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Triggering, control, and monitoring of 240 high-power klystrons will be supported by the SLC control system this summer. The control software is distributed among a VAX host computer, a local microprocessor cluster, and a dedicated intelligent CAMAC module. The functions performed by these three components and the algorithms used are discussed.

7725 **A programmable delay unit incorporating a semi-custom integrated circuit.** Linstadt, E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2112-2114(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The synchronization of SLC accelerator control and monitoring functions is realized by a CAMAC module, the PDU II (Programmable Delay Unit II, SLAC 253-002), which includes a semi-custom gate array integrated circuit. The PDU II distributes 16 channels of independently programmable delayed pulses to other modules within the same CAMAC crate. The delays are programmable in increments of 8.4 ns. Functional descriptions of both the module and the semi-custom integrated circuit used to generate the output pulses are given.

7726 **Dissecting the COW.** Linstadt, E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2115-2116(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The COW, or Console On Wheels, is the primary operator interface to the SLC accelerator control system. A hardware and software description of the COW, a microcomputer based system with a color graphics display output and touchpanel and knob inputs, is given. The ease of development and expandability, due to both the modular nature of the hardware and the multitasking, interrupt driven software running in the COW, are described. Integration of the COW into the SLCNET communications network and SLC Control system is detailed.

7727 **Error message recording and reporting in the SLC control system.** Spencer, N.; Bogart, J.; Phinney, N.; Thompson, K. (Stanford Linear Accelerator Center, Stanford University, Stanford, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2120-2122(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Error or information messages that are signaled by control software either in the VAX host computer or the local microprocessor clusters are handled by a dedicated VAX process (PARANOIA). Messages are recorded on disk for further analysis and displayed at the appropriate console. Another VAX process (ERRLOG) can be used to sort, list and histogram various categories of messages. The functions performed by these processes and the algorithms used are discussed.

7728 **Timing system control software in the SLC.** Thompson, K.; Phinney, N. (Stanford Linear Accelerator Center, Stanford University, Stanford, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2123-2125(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

A new timing system that allows precision (about1-2 ns) control of the trigger times of klystrons, beam position monitors, and other devices on a pulse-to-pulse basis at up to 360 Hz is in operation in the first third of the SLAC linear accelerator. The control software is divided between a central host VAX and local Intel 8086-based microprocessor clusters. Facilities exist to set up and adjust the timing of devices or groups of devices independently for beam pulses having different destinations and purposes, which are run in an interlaced fashion during normal machine operation. Upgrading of the system is currently underway, using a new version of the Programmable Delay Unit CAMAC module to allow pipelining of timing information for three machine pulses. An overview of the current state of the system is presented in this paper, with an emphasis on software control.

7729 **Intensity stability improvements for the intense pulsed neutron source accelerator system.** Rauchas, A.; Gunderson, G.; Stipp, V.; Volk, G.; Zolecki, R. (Argonne National Laboratory, Argonne, IL). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2126-2128(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The Intense Pulsed Neutron Source (IPNS) accelerator system consists of a 750 keV CockcroftWalton preaccelerator, 50 MeV linear accelerator and a 500 MeV Rapid Cycling Synchrotron (RCS). The accelerator system accelerates over 2.5 X 10^{12} protons per pulse at a 30 Hz rate to strike a depleted uranium target for producing neutrons, which are used for neutron scattering research. Since beginning operation in 1977, the beam intensity has been steadily increasing with improvements in various systems, such as a new H^- source, improved correction magnet systems, etc. Instabilities created by the higher intensities have also been brought under control.

7730 **Low dispersion notch filter for multi-ghz frequencies using fiber optics delays.** Simpson, J.D.; Konecny, R. (Argonne National Laboratory, Argonne, IL). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2129-2131(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Although their designs appear simple and straightforward, notch filters for application in stochastic cooling systems are frequently difficult to construct with acceptable characteristics. Problems arise because the components are less than perfect, coaxial cables have loss plus dispersion and other necessary hardware has limitations. Usually it is the delay line, typically a high quality coaxial line, which is the source of most problems. We report in this paper on the development of a notch filter which uses a laser diode/fiber optic delay line instead of a coaxial cable. Measurements of its properties indicate it to be a possible alternative to other designs. Bandwidth, dispersion, notch depth, dynamic range and intermodulation are each within the bounds of typical cooling system requirements.

7731 **Report on the SLC control system.** Phinney, N. (Stanford Linear Accelerator Center Stanford University, Stanford, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2117-2119(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The SLC control system is based on a VAX 11/780 Host computer with approximately 50 microprocessor clusters which provide distributed intelligence and control of all CAMAC interface modules. This paper presents an overview of the system including current status and a description of the software architecture and communication protocols.

7732 **Performance of a correlator filter in betatron tune measurements and damping on the NSLS booster.** Galayda, J. (National Synchrotron Light Source, Brookhaven National Laboratory, Upton, NY). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2132-2134(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

A "compensated correlator filter", described by Kramer, et al. has been used for measurement and damping of betatron oscillations in the NSLS booster. The filter consists of a zero-degree power splitter, a 180-degree splitter, a length of 7/8" air dielectric coaxial cable, and a short length of RG-58 cable. Connected to a beam position monitor, the output of the filter is proportional to the difference in transverse position of each bunch on subsequent turns. The useful bandwidth of the filter for damping rigid bunch oscillations extends from 10 MHz to 250 MHz, in contrast with the gigahertz bandwidth requirements for stochastic cooling, for which the filter was originally proposed. Attenuation of all rotation harmonics in this bandwidth is 40-60 dB.

7733 **The Tevatron global radius and 0s system.** Bristol, S.; Kerns, E.; Kerns, Q.; Miller, H.W. (Fermi National Accelerator Laboratory, Batavia, IL). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2141-2143(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

It has been found to be practical to extract a turn-average measurement of bunch beam phase relative to cavity gap voltage. The 0s signal shows the bunch position on the R.F. wave throughout injection, acceleration and extraction, including coherent synchrotron oscillations when present. In turn, the time derivative of 0s is a direct measure of global radial position error. We use the 0s signal, driving a phase shifter in the R.F. lowlevel system, to damp coherent synchrotron oscillations. Design and operation are discussed including single beam bunch operation if available.

7734 **Transient beam loading compensation in the Fermilab Main Ring.** Wildman, D. (Fermi National Accelerator Laboratory, Batavia, Illinois). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2150-2152(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

A requirement for bunch coalescing and bunch rotation for antiproton production in the Fermilab Main Ring is that the net rf voltages be reduced below about 1 kV. At high beam intensities, the fields generated by the beam in a single pass through the rf cavities will exceed this limit. The new compensation system monitors the component of the beam current at the fundamental rf frequency as a function of time. This information is then delayed by a single turn and fed back into the high level rf system to cancel the beam-induced fields. The system has compensated the beam-induced voltage generated by a single booster batch to 5% of its initial value.

7735 **High-power RF controls for the NBS-Los Alamos racetrack microtron.** Young, L.M.; Biddl, R.S. (Los Alamos National Laboratory, Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2162-2164(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The high-power rf system for the National Bureau of Standards (NBS)-Los Alamos racetrack microtron (RTM) uses waveguide power splitters and waveguide phase shifters to distribute rf power from a single 500-kw cw klystron to four side-coupled accelerating structures. The amplitude and phase of each structure is controlled by a feedback system that uses the waveguide variable power splitters, waveguide phase shifters, and klystron drive as the active control elements. The feedback controls on the capture section use low-level rf amplitude and phase controls on the rf drive to the klystron. These controls are very fast with an open loop gain bandwidth of approximately 40 kHz. The feedback loop is identical to the feedback loop used in the chopper/buncher system described in another paper at this conference.

7736 **The RF power system for the chopper/buncher system on the NBS-Los Alamos RTM.** Young, L.M.; Keffeler, D.R. (Los Alamos National Laboratory, Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2165-2170(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The rf power system and its closed-loop feedback control for the racetrack microtron (RTM) chopper/ buncher system are described. Measurements made on the response of the feedback system to external perturbations are also reported.

7737 **Beam steering in the SLC linac.** Sheppard, J.C.; Lee, M.J.; Ross, M.C.; Seeman, J.T.; Stiening, R.F.; Woodley, M.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2180-2182(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

In order to control emittance growth due to transverse wakefields it will be necessary to transport electrons and positrons through the Stanford Linear Collider (SLC) linac to within a hundred μm of the centers of the linac irises. Beam centering will be accomplished using computer routines to read stripline beam position monitors and in turn correct the orbits with dipole magnets. Several different steering algorithms have been investigated using electrons in the first third of the SLC linac lattice. The most promising scheme is a cascade of modified "three-bumps" in conjunction with long spanning harmonic corrections. General features of the orbit correcting software are discussed along with the mathematical recipes for correction. Experimental results and a discussion of future plans are presented.

7738 **Superconvergent tracking and invariant surfaces in phase space.** Ruth, R.D.; Raubenheimer, T.; Warnock, R.L. (Stanford Linear Accelerator Center, Stanford University, Stanford, CA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2206-2208(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The question of long term beam stability in very large storage rings presents an extraordinary challenge in nonlinear dynamics. Since current computational methods seem less than adequate on the long time scales involved, we have undertaken a program of evaluating several methods that either are new or have not been tried in accelerator problems heretofore. The methods we investigate fall into two categories: iteration of maps describing concatenated machine elements for tracking of single particles, and infinite-time methods for direct computation of invariant surfaces in phase space.

7739 **Los Alamos high-current proton storage ring; a status report.** Lawrence, G.P.; Clout, P.N.; Hardekopf, R.A.; Jason, A.J.; Sawyer, G.A. (Los Alamos National Lab., Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2662-2665(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The Proton Storage Ring (PSR), whose installation was recently completed at Los Alamos, is a fast-cycling high-current accumulator designed to produce intense 800 MeV proton pulses for driving a spallation neutron source. The ring converts long beam pulses from the LAMPF linear accelerator into short bunches well matched to requirements of a high-resolution neutron-scattering materials science program. The initial performance goal for this program is to provide 100-μA average current at the neutron production target within a 12-Hz pulse rate. Project construction began in May 1982, and was completed in mid-April 1985. First beam was circulated in the ring on April 26. Operation at 20 μA is scheduled for September 1985, with full intensity within the next year. The storage ring was originally designed to function in a second mode in which six l-ns bunches are accumulated and separately extracted every LAMPF macropulse. Implementation of this mode, which would serve a fast-neutron nuclear-physics program, has been deferred in favor of initial concentration on the neutron-scattering program. This paper summarizes the PSR design and status. Unique machine features include high peak current, two-step charge-stripping injection, a low-impedance buncher amplifier to counter beam-loading, and a high-repetion-rate strip-line extraction kicker.

7740 **Progress report on the NBS/Los Alamos RTM.** Penner, S.; Ayres, R.L.; Biddle, R.; Cutler, R.I.; Debenham, P.H.; Lindstrom, E.R.; Mohr, D.L.; Rose, J.E.; Uterweger, M.P.; Wilson, M.A.D. (National Bureau of Standards). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2669-2671(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The NBS-Los Alamos 200 MeV Racetrack Microtron (RTM) is being built under a program aimed at developing the

technology needed for high-current intermediateenergy CW electron accelerators. In this report we give an overview of the present status of the project. Recent progress includes: completion of testing of the 100 keV chopper-buncher system demonstrating a normalized emittance well under the design goal of 2.6 π mm mrad at currents exceeding the design goal of 600 μA; operation of the rf structures comprising the 5 MeV injector linac at power levels up to 50 kW/m, resulting in an accelerating gradient at β=1 of 2 MV/m (compared to a design goal of 1.5 MV/m). The measured shunt impedance is 82.5 MΩ/m; construction and installation of the 30 ton end magnets of the RTM. Field mapping of one magnet has been completed and its uniformity exceeds the design goal of + or - 2 parts in 10^4; performance tests (with beam) of prototype rf beam monitors which measure current, relative phase, and beam position in both transverse planes; and installation and initial operation of the primary control system.

7741 **Use of the "MURA" transformation to generate the fields and calculate the motion of protons in the designed argonne Mini-ASPUN FFAG spiral sector accelerator.** Crosbie, E.A. (Argonne National Lab., Argonne, IL). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2675-2677(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

As a long range goal for the production of high intensity neutrons, Argonne National Laboratory has proposed the construction of a 1.5-GeV FFAG Spiral Sector Accelerator called ASPUN. The 500-MeV injector for this proposed accelerator is a smaller FFAG Spiral Sector Accelerator named Mini-ASPUN. Until such a time as the larger machine could be built, it was planned that Mini-ASPUN would replace the present RCS now being used for the IPNS program at Argonne. In order to obtain an accurate estimation of the orbits and betatron oscillations in such a machine, it is necessary that realistic field values be used in the equations of motion. Obtaining these fields from 3-dimensional relaxation calculations is both time consuming and costly. However, because of the required scaling of the machine, the field-generating potential of three variables can be separated into a known function of the radius and a function of two variables. The second order differential equation satisfied by this function can be solved by ordinary relaxation methods. The fields generated from a mesh of values for this function will be accurate except for the extreme inside and outside orbits, which will be affected by the necessary termination of the inside and outside ends of the magnet.

7742 **The development of a current monitor system for measuring pulsed-beam current over a wide dynamic range.** Gallegos, F.R.; Browman, A.A.; Morrison, L.J. (MP Division, MS H-812, Los Alamos National Laboratory, Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 1959-1960(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

This report documents the development of a current transformer system to measure pulsed ion beam currents at the LAMPF accelerator. Measured peak currents typically range from 100 nA to 30 mA with pulse widths varying from 30 μs to 1 ms. Signal conditioning of the peak current output provides an average current readout with a range of 1 nA to 2 mA, noise of approximately + or - 0.5 nA, and accuracy of + or - 0.1%. The system requires no operating adjustments and has proved stable and reliable during a year of operation.

7743 **Optimizing data access in the LAMPF control system.** Schaller, S.C.; Corley, J.K.; Rose, P.A. (Los Alamos National Laboratory, Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2080-2082(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The LAMPF control system data access software offers considerable power and flexibility to application programs through symbolic device naming and an emphasis on hardware independence. This paper discusses optimizations aimed at improving the performance of the data access software while retaining these capabilities. The only aspects of the optimizations visible to the application programs are "vector devices" and "aggregate devices." A vector device accesses a set of hardware related data items through a single device name. Aggregate devices allow run-time optimization of references to groups of unrelated devices. Optimizations not visible on the application level include careful handling of: network message traffic; the sharing of global resources; and storage allocation.

7744 **NBS/LANL racetrack microtron control system.** Ayres, R.L.; Martin, E.R.; Trout, R.E.; Wilson, B.L.; Yoder, N.R. (National Bureau of Standards, Gaithersburg, Maryland). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2086-2088(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The distributed intelligence control system for the NBS/LANL racetrack microtron (RTM) is now nearing completion, with all major subsystems implemented and tested, thus providing some operating experience with most of the control system innovations. These include a triple hierarchy of microprocessor-based control elements, consisting of a primary control station and multiple secondary and tertiary control stations; light-link coupling to a tertiary station which operates at a 100 kV potential; a common database shared by separate microprocessors for handling hardware control and operator interactions; and joy stick control of the entire system. A unique secondary station interpreter program was used to great advantage for testing and checkout of various control and monitoring subsystems. The hardware design of the control system is based on Multibus I crates containing commercial Multibus I boards and a few custom designed boards. The primary-secondary data link is a high speed, bidirectional, full-duplex, 8-bit, "byte" parallel link designed for this application. This link permits very fast updating of the monitored data (> 5 per second) and timely response to operator control inputs at the primary station.

7745 **On-line model driven control of the SLC electron damping ring.** Almog, I.; Jager, J.; Lee, M.; Woodley, M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2098-2100(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Model driven procedures have been used for control of the linac, beam transport lines and storage rings at SLAC. These procedures, based upon computer models of the machine lattice, are used for on-line calculation of the strengths of beam line components which yield desired lattice parameter values. They are also used for routine operation of the machine and for diagnosing and correcting errors of various types, as well as for aiding physicists in the acquisition and presentation of data. Successful operational experience in the use of such procedures at the PEP and SPEAR storage rings has led to the decision that this method of operation will be used for control of all of the SLC subsystems: two-mile Linac, Arcs, Final Focus Region, Positron Return Line and the Damping Rings and their associated injection/extraction beam transport lines. Many procedures have been developed and used successfully for the commissioning and routine operation of the electron Damping Ring. some of these procedures have been used for controlling the injection transport system from Linac to Ring (LTR) and for the extraction transport system from Ring to Linac (RTL). The purpose of this paper is to describe the development of the on-line model driven control procedures and their implementation in the SLC computer control system.

7746 **Beam position monitor readout and control in the SLC linac.** Bogart, J.; Phinney, N.; Ross, M.; Yaffe, D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-32: No. 5, 2101-2103(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

A beam position monitoring system has been implemented in the first third of the SLC linac which provides a complete scan of the trajectory on a single beam pulse. The data is collected from the local micro-computers and viewed with an updating display at a console or passed on to application programs. The system must operate with interlaced beams so the scans are also interlaced, providing each user with the ability to select the beam, the update rate, and the attenuation level in the digitizing hardware. In addition each user calibrates the hardware for his beam. A description of the system architecture is presented.

4304 STORAGE RINGS

7747 **(LA-UR—85-3580) PSR control system.** Clout, P.N.; Conley, A.P.; Bair, S.S.; Fuka, M.A.; Sandford, E.L.; Lander, R.F.; Wells, F.D. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 17p. (CONF-8510194—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002399.

From 2. international workshop on accelerator control systems; Los Alamos, NM, USA (7 Oct 1985).

The control system for the Proton Storage Ring at Los Alamos has been essentially completed. Modifications are being applied that are required in the light of machine physics and operating experience. The present design of the system is described and future planned modifications are indicated. (LEW)

7748 **(LA-UR—85-3582) Proton storage ring: man/machine interface.** Lander, R.F.; Clout, P.N. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 26p. (CONF-8510194—5). NTIS, PC A03/MF A01; GPO Dep. File Number DE86002397.

From 2. international workshop on accelerator control systems; Los Alamos, NM, USA (7 Oct 1985).

The human interface of the Proton Storage Ring Control System at Los Alamos is described in some detail, together with the software environment in which operator interaction programs are written. Some examples of operator interaction programs are given.

7749 **(LBL—19808) Effects of magnetic non-linearities on a stored proton beam and their implications for superconducting storage rings.** Cornacchia, M.; Evans, L. (Lawrence Berkeley Lab., CA (USA)). Jun 1985. Contract AC03-76SF00098. 42p. (CONF-8503105—10). NTIS, PC A03. File Number DE86002867.

From Orbital dynamics and applications to accelerators workshop; Berkeley, CA, USA (7 Mar 1985).

A nonlinear lens may be used to study the effect of high-order multipolar field imperfections on a stored proton beam. Such a nonlinear lens is particulary suitable to simulate field imperfections of the types encountered in coil dominated superconducting magnets. We have studied experimentally at the SPS the effect of high order (5th and 8th) single isolated resonances driven by the nonlinear lens. The width of these resonances is of the order one expects to be caused by field errors in superconducting magnets of the SSC type. The experiment shows that, in absence of tune modulation, these resonances are harmless. Slow crossings of the resonance, on the other hand, have destructive effects on the beam, much more so than fast crossings caused by synchrotron oscillations. In the design of future storage rings, sources of low-frequency tune modulation should be avoided as a way to reduce the harmful effects of high order multipolar field imperfection.

44 INSTRUMENTATION

4401 RADIATION INSTRUMENTATION

REFER ALSO TO CITATION(S) 7057, 7707, 7742, 7826, 7827, 7888, 7941, 8027

7750 (BNL—51847, pp 152-160) **Area x-ray detectors for intense diffuse signals.** Gruner, S.M. (Princeton Univ., NJ). Jan 1985. NTIS, PC A09/MF A01. File Number DE85008488. (CONF-8410112—).

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

The problem of developing a suitable detector for x-ray diffraction by polymers for synchrotron radiation is pointed out as being a very pressing problem. Design, development, and implementation of synchrotron beams has been carried out by the laboratories, but the detector efforts have been left in the hands of the users. The design of an electro-optical detector designated as 2-DXD and consisting of three basic elements: an energy converter, a gain element, and a storage/readout device is described in detail.

7751 **(CERN-EP—82-170) First operation of the CERN UA1 central detector.** Placci, A. (European Organization for Nuclear Research, Geneva (Switzerland)). 12 Nov 1982. 6p. (CONF-821011—58). NTIS (US Sales Only), PC A02/MF A01. File Number DE86900288.

From IEEE nuclear science symposium; Washington, DC, USA (20 Oct 1982).

The Central Detector of the UA1 experiment at the CERN p anti p Collider underwent a first physics run at the end of 1981. The detector consists of a large drift chamber assembly (25 m^3, ~6000 sense wires). An electronics readout with multi-hit capability simultaneously digitizes the time and the analog information used for charge division and energy measurement. The initial performance of the readout and control system will also be presented. The detector was tested in two cosmic-ray runs, and is now fully operational for the second physics run; this started at the beginning of October 1982. 4 refs., 12 figs.

7752 **(EGG-M—04985) Portable beta spectrometer for tissue dose measurement.** Martz, D.E.; Rich, B.L.; Johnson, L.O. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 24p. (CONF-8510185—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86004106.

From Workshop on dosimetry of beta particles and low energy X-rays; Paris, France (7 Oct 1985).

A technique for measuring the D(.07) and D(10) dose rates in mixed beta/gamma radiation fields through the use of a tissue equivalent detector and portable multichannel analyzer has been developed and field tested. Two energy spectra are collected for each measurement, an open window spectrum representing the tissue response to betas plus photons, and a second filtered spectrum representing the photon response. A close approximation to the net beta spectrum is obtained by spectrum stripping, and the D(.07) dose rate is calculated by multiplying channel by channel by a beta energy deposition function. Computer plots of typical field spectra and dose rate calculations are presented. 3 refs., 17 figs.

7753 **(FNAL/C—85/150) Collider Detector at Fermilab (CDF).** Jensen, H.B. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1985. Contract AC02-76CH03000. 7p. (CONF-851009—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003033.

From IEEE nuclear science symposium; San Francisco, CA, USA (23 Oct 1985).

A description of the Collider Detector at Fermilab (CDF) is given. It is a calorimetric detector, which covers almost the complete solid angle around the interaction region with segmented calorimeter "towers". A 1.5 Tesla superconducting solenoid, 3m in diameter and 5m long, provides a uniform magnetic field in the central region for magnetic analysis of charged particles. The magnetic field volume is filled with a large cylindrical drift chamber and a set of Time Projection Chambers. Muon detection is accomplished

with drift chambers outside the calorimeters in the central region and with large magnetized steel toroids and associated drift chambers in the forward-backward regions. The electronics has a large dynamic range to allow measurement of both high energy clusters and small energy depositions made by penetrating muons. Interesting events are identified by a trigger system which, together with the rest of the data acquisition system, is FASTBUS based.

7754 **(FNAL/C—85/156) Rabbit System. Low cost, high reliability front end electronics featuring 16 bit dynamic range.** Drake, G.; Droege, T.F.; Nelson, C.A. Jr.; Turner, K.J.; Ohska, T.K. (Fermi National Accelerator Lab., Batavia, IL (USA); National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Oct 1985. Contract AC02-76CH03000. 7p. (CONF-851009—21). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003030.

From IEEE nuclear science symposium; San Francisco, CA, USA (23 Oct 1985).

A new crate-based front end system has been built which features low cost, compact packaging, command capability, 16 bit dynamic range digitization, and a high degree of redundancy. The crate can contain a variety of instrumentation modules, and is designed to be situated close to the detector. The system is suitable for readout of a large number of channels via parallel multiprocessor data acquisition.

7755 **(FNAL-TM—1358) CDC field mapping device - "ROTOTRACK".** Yamada, R.; Hawtree, J.; Kaczar, K.; Leverence, R.; McGuire, K.; Newman-Holmes, C.; Schmidt, E.E.; Shallenberger, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1985. Contract AC02-76CH03000. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002549.

A field mapping device for the magnet of the Collider Detector at Fermilab (CDF) was constructed. The device was used for extensive study of the CDF magnetic field distribution. The mechanical and electrical features of the device, as well as the data acquisition system and software, are described. The mechanical system was designed so that the errors on the position and angle of the probe were +-0.75 mm and +-1 mrad, respectively.

7756 **(FNAL-TM—1363) Real time data compactor (sparsifier) and 8 megabyte high speed FIFO for HEP.** Baumbaugh, A.E.; Knickerbocker, K.L.; Wegner, C.R.; Baumbaugh, B.W.; Ruchti, R. (Fermi National Accelerator Lab., Batavia, IL (USA); Notre Dame Univ., IN (USA)). Oct 1985. Contract AC02-76CH03000. 5p. (CONF-851009—26). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003546.

From IEEE nuclear science symposium; San Francisco, CA, USA (23 Oct 1985).

A Video-Data-Acquisition-System (VDAS) has been developed to record image data from a scintillating glass fiber-optic target developed for High Energy Physics. The major components of the VDAS are a flash ADC, a "real time" high speed data compactor, and high speed 8 megabyte FIFO memory. The data rates through the system are in excess of 30 megabytes/second. The compactor is capable of reducing the amount of data needed to reconstruct typical images by as much as a factor of 20. The FIFO uses only standard NMOS DRAMS and TTL components to achieve its large size and high speed at relatively low power and cost.

7757 **(LA—10470-M) Dounreay Shuffler diagnostic software operations manual.** Eccleston, G.W.; Stuewe, B.; Klosterbuer, S.; Van Lyssel, T. (Los Alamos National Lab., NM (USA)). Jul 1985. Contract W-7405-ENG-36. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86003294.

This operations manual describes the test software for the Dounreay Shuffler. The Shuffler is an assay system, controlled by a Commodore PET computer, that measures the plutonium content in leached hulls at the fuel reprocessing plant in Dounreay, Scotland. The Shuffler contains a ^{252}Cf neutron source that is moved between storage and irradiation locations to obtain measurement data. A stepping motor control (SMC) module operates the Shuffler and accepts commands from the PET to move the source. This manual briefly describes the Shuffler and provides details on running and using the diagnostic software program. The communications protocol for message transmittal between the PET and SMC is defined and a detailed example of message sending is presented in an appendix.

7758 **(LA-UR—85-3544) Investigations of fluctuations in instrumental responses by principal components analysis.** Wangen, L.E.; Bentley, G.E.; Hamilton, V.T.; Peterson, E.J. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 8p. (CONF-8510151—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002385.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

Principal components analysis was evaluated as a chemometric method for investigating the sources of variation in multicomponent analytical instruments. Many measurements of a 20-element standard were made over several days of operation with a direct-current argon plasma emission spectrometer designed to simultaneously measure the emission intensity at 20 analytical wavelengths. The number of components necessary to account for signal variations and the interelement correlations were determined by a principal components analysis. These results were used to identify the minimum number of independent sources of instrument variation and therefore the minimum number of internal standards needed to correct nonrandom fluctuations in instrument response. Correlations of the analytical signals with the principal components provide guidance for selecting internal standards. 7 refs., 2 figs.

7759 **(LBL—19665) Detection of charged particles in amorphous silicon layers.** Kaplan, S.N.; Morel, J.R.; Mulera, T.A.; Perez-Mendez, V.; Schnurmacher, G.; Street, R.A. (Lawrence Berkeley Lab., CA (USA); Xerox Palo Alto Research Center, CA (USA)). Oct 1985. Contract AC03-76SF00098. 7p. (CONF-851009—30). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003992.

From IEEE nuclear science symposium; San Francisco, CA, USA (23 Oct 1985).

The successful development of radiation detectors made from amorphous silicon could offer the possibility for relatively easy construction of large area position-sensitive detectors. We have conducted a series of measurements with prototype detectors, on signals derived from alpha particles. The measurement results are compared with simple model calculations, and projections are made of potential applications in high-energy and nuclear physics. 4 refs., 7 figs.

7760 **(PINSTECH/NPD—112(FNPG)) Full energy and double escape peak efficiencies of intrinsic germanium detector.** Ahmad, M.; Saleem, S.M.; Anwar, M.; Gul, K.; Khan, N.A. (Pakistan Inst. of Nuclear Science and Technology, Islamabad. Nuclear Physics Div.). Apr 1984. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86700186.

This paper presents experimental measurements of absolute full energy peak efficiency of 61.4 cc intrinsic germanium detector in the gamma-ray energy range 50 keV to 8.6 MeV using standard radioactive sources and thermal neutron capture in ^{35}Cl. For the determination of double escape peak efficiency of the detector from 2.8 MeV to 9.7 MeV, the gamma-rays following thermal neutron capture in sup(50,52,53)Cr and ^{35}Cl are used. The overall accuracy is between 1% for double escape peak efficiencies. The efficiency curves are fitted using 3rd degree polynomials.

7761 **(SLAC-PUB—3777) Waveform Sampler CAMAC Module.** Freytag, D.R.; Haller, G.M.; Kang, H.; Wang, J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Tsinghua Univ., Beijing (China)). Sep 1985. Contract AC03-76SF00515. 5p. (CONF-851009—15). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002938.

From IEEE nuclear science symposium; San Francisco, CA, USA (23 Oct 1985).

A Waveform Sampler Module (WSM) for the measurement of signal shapes coming from the multi-hit drift chambers of the SLAC SLC detector is described. The module uses a high speed, high resolution analog storage device (AMU) developed in collaboration between SLAC and Stanford University. The AMU devices

together with high speed TTL clocking circuitry are packaged in a hybrid which is also suitable for mounting on the detector. The module is in CAMAC format and provides eight signal channels, each recording signal amplitude versus time in 512 cells at a sampling rate of up to 360 MHz. Data are digitized by a 12-bit ADC with a 1 μs conversion time and stored in an on-board memory accessible through CAMAC.

7762 **(SLAC-PUB—3790) Charge division using carbon filaments for obtaining coordinate information from detection of single electrons.** Bird, F.; Shapiro, S.; Ashford, V.; McShurley, D.; Reif, R.; Lirth, D.W.G.S.; Williams, S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1985. Contract AC03-76SF00515. 6p. (CONF-851009—17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002942.

From IEEE nuclear science symposium; San Francisco, CA, USA (23 Oct 1985).

Seven micron diameter Carbon filaments forming the anode of a multiwire proportional chamber have been used to detect single electrons. Charge division techniques applied to the 5 cm long wire resulted in a position resolution of $\sigma/L < 2\%$ for a collected signal charge of 30 fC.

7763 **(SLAC-PUB—3811) Performance of the SLD Warm Iron Calorimeter pre-prototype.** Johnson, A.S.; Busza, W.; Friedman, J.; Kendall, H.; Kistiakowsky, V.; Lyons, T.; Osborne, L.S.; Rosenson, L.; Verdier, R.; Carumbalis, D. (Massachusetts Inst. of Tech., Cambridge (USA); Columbia Univ., Irvington-on-Hudson, NY (USA). Nevis Labs.; Stanford Linear Accelerator Center, Menlo Park, CA (USA); Wisconsin Univ., Madison (USA)). Oct 1985. Contract AC02-76ER03069;AC02-76ER00881;AC03-76SF00515. 5p. (CONF-851009—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002944.

From IEEE nuclear science symposium; San Francisco, CA, USA (23 Oct 1985).

The performance of a pre-prototype of the SLD Warm Iron Calorimeter (WIC) build with proportional tube cathode pad readout has been studied. The calorimeter was found to have an average resolution of 36.7 +- 0.2% for muons at 2.0, 5.0 and 10.5 GeV and 81 +- 2%/$\sqrt{E}$ for pion showers at 5.0 and 10.5 GeV. The mean energy found for the pion showers was consistent with a linear dependence on energy within these standard deviations. 4 refs., 6 figs., 3 tabs.

7764 **(UCRL—92719) High-pressure ^{3}He gas scintillation neutron spectrometer.** Derzon, M.S.; Slaughter, D.R.; Prussin, S.G. (California Univ., Berkeley (USA). Dept. of Nuclear Engineering; Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 4p. (CONF-851009—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002856.

From IEEE nuclear science symposium; San Francisco, CA, USA (23 Oct 1985).

A high-pressure, ^{3}He-Xe gas scintillation spectrometer has been developed for neutron spectroscopy on D-D fusion plasmas. The spectrometer exhibits an energy resolution of (121 +- 20 keV) keV (FWHM) at 2.5 MeV and an efficiency of (1.9 +- 0.4) x 10^{-3} $(n/cm^2)^{-1}$. The contribution to the resolution (FWHM) from counting statistics is only (22 +- 3 keV) and the remainder is due predominantly to the variation of light collection efficiency with location of neutron events within the active volume of the detector.

7765 **(UCRL—92816) Considerations for application of Si(Li) detectors in analyses of sub-keV, ion-induced x rays.** Musket, R.G. (Lawrence Livermore National Lab., CA (USA)). 19 Jun 1985. Contract W-7405-ENG-48. 20p. (CONF-850716—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003196.

From 7. international conference on ion beam analysis; Berlin, F.R. Germany (7 Jul 1985).

Spectroscopy of ion-induced x rays is commonly performed using lithium-drifted, silicon detectors, Si(Li), with beryllium windows. Strong absorption of x rays with energies below 1 keV occurs in even the thinnest commercially available beryllium windows and precludes useful analysis of sub-keV x rays. Access to the sub-keV x ray region can be achieved using windowless (WL) and ultra-thin-windowed (UTW) Si(Li) detectors. These detectors have been shown to be useful for spectroscopy of x rays with energies above approximately 200 eV. The properties of such detectors are reviewed with regard to analysis of ion-induced x rays. In particular, considerations of detection efficiency, output linearity, energy resolution, peak shapes, and vacuum requirements are presented. The use of ion excitation for determination of many detector properties serves to demonstrate the usefulness of WL and UTW detectors for the spectroscopy of sub-keV, ion-induced x rays. 23 refs., 4 figs.

7766 **Brightness measurements on the livermore high brightness test stand.** Caporaso, G.J.; Birt, D.L. (Lawrence Livermore National Laboratory, Livermore, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2608-2610(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Several techniques using small radius collimating pipes with and without axial magnetic fields to measure the brightness of an extracted 1 - 2 kA, 1 - 1.5 MeV electron beam is described. The output beam of the High Brightness Test Stand as measured by one of these techniques is in excess of 2 X 10_8 amp/cm/$_2$/steradian.

7767 **Improved tracking codes: present and future.** Servranckx, R.V. (University of Saskatchewan, Saskatoon, Saskatchewan). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 5, 2186-2190(Oct 1985). (CONF-850504—).

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The paper identifies conditions which tracking codes should meet. The constraints come from mathematics, physics, computer environment and user requirements. There is no intention to do an exhaustive study of existing codes. Only single particle tracking codes are considered. When many particles are followed they have no interaction with each other. The paper ends with comments on present efforts to meet some of the conditions identified.

7768 **New method of proportional counter feedback biasing for wide-range radiation dose-rate monitors.** Kopp, M.K.; Gueerant, G.C.; Manning, F.W.; Valentine, K.H. (Oak Ridge National Lab., Oak Ridge, TN). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 1, 966-968(Feb 1985). (CONF-841007—).

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

A prototypic wide-range radiation dose-rate monitor for civil defense applications has been developed and tested. The specified dose-rate range (0 to 500 R/h) was displayed on a single readout scale by using feedback-controlled biasing of a proportional counter. This new method is based on controlling the avalanche multiplication factor (gas gain) of the counter by varying its bias voltage in response to its measured output current (i.e., detected dose rate). The counter output current varies between 0 and 1.5 nA in a quasilogarithmic response to dose rates between 0 and 500 R/h. The corresponding values of gas gain and bias voltage range from 1 to 300 and 200 to 1900 V respectively.

7769 **A beta-gamma discriminator circuit.** Erkkila, B.H.; Brake, R.J.; Eisen, Y.; Unruh, W.P.; Wolf, M.A. (Los Alamos National Lab., Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 1, 969-971(Feb 1985). (CONF-841007—).

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

The major difficulty encountered in the determination of beta-ray dose in field conditions is generally the presence of a relatively high gamma-ray component. Conventional dosimetry instruments use a shield on the detector to estimate the gamma-ray component in comparison with the beta-ray component. More accurate dosimetry information can be obtained from the measured beta

spectrum itself. At Los Alamos, a detector and discriminator circuit suitable for use in a portable spectrometer have been developed. This instrument will discriminate between gammas and betas in a mixed field. The portable package includes a 256-channel MCA which can be programmed to give a variety of outputs, including a spectral display, and may be programmed to read dose directly.

7770 **A field test and evaluation of the Simultaneous Calorimetric Assay System.** Rakel, D.A.; Elmont, T.H.; Wetzel, J.R. (Rockwell International Golden, Colorado). *Nuclear Materials Management;* **13**: 178-185(Jul 1984). (CONF-840734—).

From 25. annual meeting of the Institute of Nuclear Materials Management; Columbus, OH, USA (15 Jul 1984).

The Simultaneous Calorimetric Assay System measures the thermal power of a sample by calorimetry and the relative concentrations of the heat producing nuclei in the sample simultaneously. This transportable instrument provides a nondestructive determination of the plutonium content of the sample. This paper describes the instrument and its performance in a field test conducted by the Chemical Standards Laboratory at Rockwell International, Rocky Flats Plant, in the summer of 1983.

4402 RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

REFER ALSO TO CITATION(S) 7677

7771 **(LA-UR—85-3803) Radiation effects on video imagers.** Yates, G.J.; Bujnosek, J.J.; Jaramillo, S.A.; Walton, R.B.; Martinez, T.M.; Black, J.P. (Los Alamos National Lab., NM (USA); EG and G, Inc., Los Alamos, NM (USA); EG and G, Inc., Albuquerque, NM (USA). Kirtland Operations). 1985. Contract W-7405-ENG-36. 9p. (CONF-851009—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002435.

From IEEE nuclear science symposium; San Francisco, CA, USA (23 Oct 1985).

Radiation sensitivity of several photoconductive, photoemissive, and solid state silicon-based video imagers was measured by analyzing stored photocharge induced by irradiation with continuous and pulsed sources of high energy photons and neutrons. Transient effects as functions of absorbed dose, dose rate, fluences, and ionizing particle energy are presented.

4403 MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 7192, 7647, 7800, 7816

7772 **(CNEA—472) Calculation method of the desiccant amount for the protection of packed electronic equipment and its comparison with other methods currently used. Application of the anhydrous silica gel as desiccant.** Del Valle, J.C.; Guido, O.O. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1982. 22p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. File Number DE86700189.

The silica gel characteristics and properties are reviewed from the viewpoint of its use as a desiccant under static conditions. There were developed two calculation methods of the desiccant amount required for the protection from moisture of electronic equipment packed into rigid synthetic foam containers, for a given period and with an adequate safety margin. Besides, MIL specification methods applicable to these types of packages have also been included. The proposed method considers the depression due to the contraction of the inside air volume during the temperature decrease periods as the only cause of the water vapor ingress into the container, the moisture permeation by diffusion through the closed cell synthetic foams being negligible. Owing to the marked thermal inertia of the package material, the thermal amplitude inside the container is lower than the outside thermal amplitude; therefore the method includes the calculation of the former. The other method is based on a procedure applicable to large storage rooms, briefly described in the literature, and where the moisture entrance is due to the above mentioned cause. A test to verify the reliability of the estimation is proposed. Finally, the amount of silica gel required for the protection of an electronic equipment packed in a given container has been calculated by the aforementioned methods, and the results compared. The value found by the proposed method was over 30% lower than that obtained by the most adequate procedure described in the MIL specification.

7773 **(DP-MS—85-127) Online fiber-optic photometer.** Van Hare, D.R.; Prather, W.S.; Boyce, D.A.; Spencer, W.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 17p. (CONF-8510178—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003142.

From Du Pont process analytical symposium; Wilmington, DE, USA (16 Oct 1985).

The development and implementation of a fiber-optic photometer for process control at the Savannah River Plant (SRP) will be discussed. The instrument is a modified Du Pont 400 photometric analyzer which incorporates quartz fiber-optic cables, a high-intensity tungsten-halogen lamp source, and a sight glass with sealed optics. Six of these photometers have been installed at SRP to monitor the elution of neptunium or plutonium from anion exchange columns. The fiber optics allow the instrument to be located 50 feet from the sight glass, which is in a highly radioactive area. This ensures easy access to the instrument and minimizes radiation exposure to personnel. The modifications to the analyzer and its application to process control will be presented.

7774 **(DP-MS—85-142) Development and performance of on-line uranium analyzers.** Ofalt, A.E.; O'Rourke, P.E. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Oct 1985. Contract AC09-76SR00001. 24p. (CONF-8510178—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003141.

From Du Pont process analytical symposium; Wilmington, DE, USA (16 Oct 1985).

A diode-array spectrophotometer and and x-ray fluorescence analyzer were installed online in a full-scale prototype facility to monitor uranium loading and breakthrough of ion exchange columns. Uranium concentrations of 10 ppM in uranyl nitrate solutions can be detected online to improve process control and material accountability. 9 figs.

7775 **(EGG—10282-2083) Laser-induced fluorescence of europium-doped yttrium oxide for remote high-temperature thermometry.** Cates, M.R.; Allison, S.W.; Franks, L.A.; Borella, H.M.; Marshall, B.R.; Noel, B.W. (Martin Marietta Energy Systems, Oak Ridge, TN (USA); EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations; Los Alamos National Lab., NM (USA)). 1985. Contract AC08-83NV10282. 6p. (CONF-8511103—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003028.

From ICALEO international congress on the applications of lasers and electro-optics; San Francisco, CA, USA (11 Nov 1985).

The refractory, Y_2O_3, doped with Eu, is suitable for high-temperature surface thermometry when activated by a uv laser. The 612-nm fluorescence lifetime has a logarithmic dependence with temperature from about 700°C to beyond 930°C. Many applications are possible, with specific emphasis on rapidly rotating turbine components operating at high temperatures.

7776 **(EGG-MS—6958) Ultrasonic pulser and receiver/preamplifier system with extended dynamic range and low baseline distortion.** Beller, L.S.; Johnson, L.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1985. Contract AC07-76ID01570. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002306.

Conventional design practice in commercial and laboratory ultrasonic instrumentation results in performance which is less than ideal for many advanced applications in research and in automated systems. The major problems with most such instrumentation can be traced to inadequate dynamic range and to baseline distortion arising from AC coupling between stages. This is a preliminary report on an ultrasonic pulser and receiver/preamplifier system

having greatly expanded sensitivity and lower noise characteristics in many ultrasonic applications. In at least one application of the new instruments, an improvement of 30 to 40 dB in dynamic range can be achieved.

7777 **(FNAL-TM—1200) Ziptrack manual.** Ito, A.; Bosworth, W.; Rutherford, J.; Lynch, A.; Tung, L.; Yang, W. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jul 1983. Contract AC02-76CH03000. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86003551.

A phenolic cart holding 3 mutually perpendicular search coils is moved through an luminum beam into the magnetic field. Coil voltages re integrated and digitized through a Data Translation 1712 ADC. The cart is controlled and the data is processed by an on-line PDP-11/05 computer. The results are displayed on a Tektronix 4010 terminal, stored on 9 track, 800 bpi tapes, and optionally recorded on a hard copy. Software on a floppy disk controls the system. The position of the cart is located by an encoder and is checked along the beam line by optical switches. One encoder count equals 0.01945 in.. The X and Y positions are changed by manipulators at each end of the beam. 625 horizontal or 500 vertical counts equal 1 in.. The desired field mapping can be automatically set up by programming a grid of encoder counts on the "SHOW STATUS" chart. A ziptrack command summary is given. Following that is a typical procedure for ziptrack operations. Also attached are time constants for the integrators and coil calibrations for 30 ft. and 100 ft. long cables.

7778 **(FRNC-TH—2065) Contribution to the study of static and dynamic operating of amorphous Si:M thin film transistors.** Leroux, T. (Institut National Polytechnique, 38 - Grenoble (France)). Nov 1984. 200p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE86750306.

This thesis presents an analytical model of static and dynamic behaviour of hydrogenated amorphous silicium (a-Si:H) thin film transistor (TFT). This analysis based on exponential distribution of localized states allow to explain its characteristics. Developed expressions are faced to experimental results given by different characterization methods (static methods, MIS capacity studies, TET response measurement in transient regime..). That allowed to bring about every model parameter. Some application of this work are presented (interters study, simulation).

7779 **(LBL—19640) Wide dynamic range portable 60-Hz magnetic dosimeter with data acquisition capabilities.** Lo, C.C.; Fujita, T.Y.; Geyer, A.B.; Tenforde, T.S. (Lawrence Berkeley Lab., CA (USA)). May 1985. Contract AC03-76SF00098. 6p. (CONF-851009—28). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003996.

From IEEE nuclear science symposium; San Francisco, CA, USA (23 Oct 1985).

A portable dosimeter has been developed for monitoring human exposure to power-frequency magnetic fields in residential and occupational environments. The microprocesssor-controlled dosimeter has been designed to measure 60-Hz field intensities that vary from 20 μG to 600 mG, thereby convering the broad range of field levels generally encountered in households and occupational settings. A digitized resolution of 2.5 μG is provided in the 20 μG to 10 mG range, and 150 μG resolution in the 10 mG to 600 mG range. Automatic range switching is implemented for both signal processing and data acquisition. 7 refs., 4 figs.

7780 **(N—84-23805) First infrared radiation detector.** (Joint Publications Research Service, Arlington, VA (USA)). Mar 1984. 2p. NTIS, PC A03/MF A01.

The first in the world noncooled photon detector designed for the detection of infrared radiation of wave length 8-12 micrometers (optimized wave length 10.6 micrometers) has been manufactured in the Plasma Physics and Laser Microsynthesis Institute, in close cooperation with the Technical Military Academy. The father of the technology is Professor Piotrowski from the Technical Military Academy while the construction and idea of utilization of the new instrument stem from the Plasma Physics and Laser Microsynthesis Institute in Warsaw. The elaboration of a new and really sensational technology was the logical outcome of research work carried out in Poland on cadmium-mercury telluride. And it was just on the basis of that new semiconductor that the noncooled infrared radiation detector has been constructed.

7781 **(PNL-SA—13446) Field data acquisition hardware.** Schuster, G.J. (Pacific Northwest Labs., Richland, WA (USA)). Sep 1985. Contract AC06-76RL01830. 8p. (CONF-8510218—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001772.

From Field data acquisition for building and equipment energy-use monitoring national workshop; Dallas, TX, USA (16 Oct 1985).

Direct metering of electrical energy flows to specific end-uses in commercial buildings is an important adjunct to evaluation of possible conservation savings as a result of weatherization or equipment optimization measures. In order to support a number of building studies sponsored by the US Department of Energy (DOE) and later by the Bonneville Power Administration, an effort was initiated at Pacific Northwest Laboratory (PNL) to develop a low-cost method for carrying out such metering. After several pilot studies, a decision was made to engineer a microprocessor-based field data acquisition system (FDAS) tailored for the specific job of metering electrical energy flows in complex commercial buildings. This document provides a functional description of the FDAS design. A section on the hardware describes in some detail the functionality of the FDAS, and is followed by a description of the sensors which measure energy use and other parameters that affect energy use. The final section provides a description of the system's software.

7782 **Design and testing of a high-temperature emissometer for porous and particulate dielectrics.** Vader, D.T.; Viskanta, R.; Incropera, F.P. (School of Mechanical Engineering, Purdue University, West Lafayette, Indiana 47907). *Review of Scientific Instruments;* **57**: No. 1, 87-93(Jan 1986). Contract FG22-81PC40789.

A new, high-temperature (500—1500 °C) emissometer has been designed, assembled, and tested. The apparatus is unique in that it may be used to measure the emittance of media that are semitransparent and show substantial surface roughness, internal voidage, and/or chemical inhomogeneities throughout the emitting volume. Data reduction procedures are developed and an analysis of systematic error sources and experimental uncertainty is presented. The emittance of a high-purity alumina was measured at several temperatures in the wavelength range from 2 to 14 μm. Results are compared to published values.

7783 **Imaging differential polarization microscope with electronic readout.** Mickols, W.; Tinoco, I.; Katz, J.E.; Maestre, M.F.; Bustamante, C. (Chemistry Department and Laboratory of Chemical Biodynamics, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* **56**: No. 12, 2228-2236(Dec 1985).

A differential polarization microscope forms two images: one of the transmitted intensity and the other due to the change in intensity between images formed when different polarizations of light are used. The interpretation of these images for linear dichroism and circular dichroism are described. The design constraints on the data acquisition systems and the polarization modulation are described. The advantage of imaging several biological systems which contain optically anisotropic structures are described.

7784 **Large aperture, high-speed calorimeter for high-energy optical pulses.** Niimura, M.; Dooling, J.; Zich, R.L.; Brock, R.N.; York, T.M. (Departments of Electrical Engineering and Aerospace Engineering, The Pennsylvania State University, University Park, Pennsylvania 16802). *Review of Scientific Instruments;* **56**: No. 12, 2253-2258(Dec 1985). Contract AC02-76ET53018.

A radiometric calorimeter is described in which the energy absorber works at the same time as a temperature sensor so that thermal equilibrium for the entire volume of absorber is not required before measuring an incident energy. The achievable frequency response is therefore quite high, and this is not offset by the size and/or damage threshold of energy receiver. The device, for-

merly called Rat's Nest Calorimeter (RNC), has been found quite useful for measuring the total energy of modern pulsed lasers with a large beam cross section. The aperture (presently 6 cm) can be increased arbitrarily without degrading the rise time. Excellent stability and high damage threshold (>>439 MW/cm²) result when a thick wire bolometer and amplifier combination is used. Response time (~9 μs) and spectral flatness are much better than previously reported. Potentials of the RNC for measuring any energy which it absorbs up to 2 kJ at the rise time 60 ns (~10 MHz) are discussed. The maximum sensitivity of the model 3.5 mJ/cm² is sufficient to detect the radiative energy emitting from today's fusion test plasmas.

7785 **Light-operated proximity detector with linear output.** Simpson, M. L.; McNeilly, D. R. (to The United States of America as represented by the United States Department of Energy). US Patent 4,516,020. 7 May 1985. Filed date 28 Dec 1982. vp.

PAT-APPL-453982.

A light-operated proximity detector is described in which reflected light intensity from a surface whose proximity to the detector is to be gauged is translated directly into a signal proportional to the distance of the detector from the surface. A phototransistor is used to sense the reflected light and is connected in a detector circuit which maintains the phototransistor in a saturated state. A negative feedback arrangement using an operational amplifier connected between the collector and emitter of the transistor provides an output at the output of the amplifier which is linearly proportional to the proximity of the surface to the detector containing the transistor. This direct proportional conversion is true even though the light intensity is varying with the proximity in proportion to the square of the inverse of the distance. The detector may be used for measuring the distance remotely from any target surface.

7786 **Pulse flux measuring device.** Riggan, W. C. (to The United States of America as represented by the United States Department of Energy). US Patent 4,516,028. 7 May 1985. Filed date 8 Mar 1983. vp.

PAT-APPL-473283.

A device for measuring particle flux comprises first and second photodiode detectors for receiving flux from a source and first and second outputs for producing first and second signals representing the flux incident to the detectors. The device is capable of reducing the first output signal by a portion of the second output signal, thereby enhancing the accuracy of the device. Devices in accordance with the invention may measure distinct components of flux from a single source or fluxes from several sources.

7787 **Explosives detection The problem and prospects.** Conrad, F.J. (Sandia National Laboratory, Albuquerque, NM). *Nuclear Materials Management;* **13**: 212-215(Jul 1984). (CONF-840734—).

From 25. annual meeting of the Institute of Nuclear Materials Management; Columbus, OH, USA (15 Jul 1984).

Explosives molecules have a number of unique properties. These properties are discussed. They include low vapor pressures, electronegativity, "stickiness," frangibility, and thermal instability. The program for developing an advanced explosives detector is described.

7788 **Mass spectrometry/mass spectrometry as a screening method for detecting explosive vapors.** Glish, G.L.; Carter, J.A.; McLuckey, S.A. (Oak Ridge National Laboratory, Oak Ridge, TN). *Nuclear Materials Management;* **13**: 216-219(Jul 1984). (CONF-840734—).

From 25. annual meeting of the Institute of Nuclear Materials Management; Columbus, OH, USA (15 Jul 1984).

Mass spectrometry/mass spectrometry (MS/MS) is a relatively new technique for trace analysis. This technique has great potential for the identification of explosive vapors. This paper gives a brief overview of MS/MS with emphasis on the characteristics that make it a likely method for explosive detection. Some preliminary data are presented and a new MS/MS instrument being designed and built for detection of trace explosive vapors is discussed.

4404 WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 6973

45 EXPLOSIONS AND EXPLOSIVES

4501 CHEMICAL

REFER ALSO TO CITATION(S) 6945

7789 **(MLM—3312(OP)) Compatibility of ultrafine TATB with 303 stainless steel.** Lavoie, J.M. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1985. Contract AC04-76DP00053. 4p. (CONF-8510232—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003448.

From 13. Department of Energy (DOE) compatibility meeting; Oak Ridge, TN, USA (15 Oct 1985).

The MSAD is a complex mechanical device where function is dependent on the free movement of small parts. A primary compatibility concern in that all the prerequisites for chloride pitting corrosion may be present in such applications. Factors considered include the presence of water and chloride, which TATB is known to contain, as well as sulfur and manganese which are present in 303 SS. In order to assess these concerns, MSAD materials were aged in humidity chambers where the 303 SS/TATB interface is maintained.

7790 **Microscopic evidence that the nitromethane aci ion is a rate controlling species in the detonation of liquid nitromethane.** Engelke, R.; Earl, W.L.; Rohlfing, C.M. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **84**: No. 1, 142-146(1 Jan 1986).

We present microscopic evidence that the aci ion ($H_3CNO^-_2$) of nitromethane (H_3CNO_2) plays an important role in the detonation kinetics of liquid-phase nitromethane. It is known from previous detonation experiments that very minute additions of organic bases (e.g., amines) have a profound effect on the detonation properties of nitromethane; i.e., the explosive is strongly sensitized. Here we show that, under conditions similar to the detonation experiments, the only new chemical species generated in nitromethane by the bases sodium hydroxide (NaOH), diethylenetriamine ($NH_2CH_2CH_2NHCH_2CH_2NH_2$), and pyridine ($C_5H_5N$) is the aci ion, within the sensitivity of the experiments. The primary tool used to demonstrate this is ^{13}C NMR spectroscopy. Ab initio quantum-mechanical calculations of the chemical shifts are used to support the experimental interpretation. Qualitative arguments concerning the increased reactivity of the aci ion, relative to normal nitromethane, are given. We review earlier work and relate it to the current findings.

7791 **Fast shutter apparatus.** Zimmermann, E.L.; Kania, D.R. (to Dept. of Energy). US Patent 4,515,173. 7 May 1985. Filed date 27 Jun 1984. vp.

PAT-APPL-625322.

An apparatus is described for protecting diagnostic equipment from blast damage by rapidly interposing a shutter between the equipment and the blast area. The apparatus comprises a sensor for sensing a trigger signal associated with the blast and for converting it into a voltage pulse. The voltage pulse is received by the first end of a firing pin. A pressure chamber holds a gas under pressure. The second end of the firing pin is located inside the pressure chamber and is located above a foil member covering an orifice. When the voltage pulse reaches the second end, a point-to-plane discharge ruptures the foil, allowing the gas to enter a drive housing and quickly move a drive piston away from the foil. A drive rod connects the drive piston to a shutter and as the drive piston is moved down, the shutter moves into a closed position, protecting the equipment from debris.

4502 NUCLEAR

REFER ALSO TO CITATION(S) 7857, 7879

7792 (AD-A—995246/6/XAB) Operation TUMBLER-SNAPPER, Nevada Proving Ground. Project 1.8. A geological survey of the Atomic Energy Commission Area, Nye County, Nevada. Report for April-June 1952. Johnson, M.S.; Hibbard, D.E. (Defense Atomic Support Agency, Washington, DC (USA)). Mar 1953. 129p. NTIS, PC A07/MF A01.

The purpose of this survey was to provide basic geological information of an area which hitherto had not been investigated in detail. The Nevada Proving Grounds Area is located in southern Nevada about 70 miles northwest of Las Vegas. It lies in the Basin and Range province and consists generally of two large valleys, Yucca Flat and Frenchman Flat, both surrounded and separated from one another by hills and mountains of variable relief. Sixteen Paleozoic formations and one Tertiary formation have been recognized within the area. Structurally, the area is complex. Compressional forces of Mesozoic age, actively applied from the west, produced uplift with attendant folding and contemporaneous thrust faulting, the latter being produced probably in Cretaceous time. The Lower Paleozoic rocks exposed east of Yucca Flat probably make up a large thrust plate that overlies Upper Paleozoic strata, which are exposed only west of the valley. Normal faulting began in early Tertiary time.

7793 (CONF-860116—1) Methodology to assess the effects of magnetohydrodynamic electromagnetic pulse (MHD-EMP) on power systems. Legro, J.R.; Abi-Samra, N.C.; Crouse, J.C.; Tesche, F.M. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.; LuTech, Inc., Berkeley, CA (USA)). 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86000089.

From IEEE winter power meeting; New York City, NY, USA (1 Jan 1986).

This paper summarizes a method to evaluate the possible effects of magnetohydrodynamic-electromagnetic pulse (MHD-EMP) on power systems. This method is based on the approach adapted to study the impact of geomagnetic storms on power systems. The paper highlights the similarities and differences between the two phenomena. Also presented are areas of concern which are anticipated from MHD-EMP on the overall system operation. 12 refs., 1 fig.

7794 (DOE/OR/21400—T206) Strategic Defense Initiative Program. Bartine, D. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002962.

7795 (LA—10566-MS) Kingfish striations and the Kelvin-Helmholtz instability. Part 1. Hunter, J.H. Jr. (Los Alamos National Lab., NM (USA)). Oct 1985. Contract W-7405-ENG-36. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004378.

The role of the Kelvin-Helmholtz instability in initiating the formation of the density striations observed in the Kingfish fireball is examined. Two idealized models are proposed for the velocity shear layer on the sides of the fireball, each of which includes essential characteristics of the Kingfish event insofar as the development of Kelvin-Helmholtz instabilities is concerned. A complete linear analysis is presented for each model.

7796 (SAND—85-1096) Transient response of an infinite wire in a dissipative medium. Chen, K.C. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1985. Contract AC04-76DP00789. 48p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003966.

Currents on a buried wire due to both a localized voltage source and a normal incident wave from above an air-ground interface are calculated using a theory developed earlier. The diffusion limit is carried out to give the following: (1) universal curves for numerical applications, and (2) the effect of an air-ground interface.

4503 EXPLOSION DETECTION

7797 (N—85-11495) Seismology 1983: Nuclear test ban verification, earthquake and Earth resource investigation. Progress report, 1983. (Research Inst. of National Defence, Stockholm (Sweden)). May 1984. vp. (FOA-C—20537-T1). NTIS, PC A05/MF A01.

Original contains color illustrations.

Dectection seismology, local seismicity in Sweden, and seismic exploration are discussed. In 1983, China exploded 1 nuclear device, France 7, the United Kingdom 1, the United States 15, and the Soviet Union 27. All explosions were underground, and below the 150 kton limit. The development of international data centers for seismic discrimination and nuclear explosion monitoring seismic risk estimation at nuclear power plants and seismic cross hole measurement investigation of crystalline rock are treated. (ESA)

7798 (SAND—85-2093) Estimation of seismic spatial coherence and its application to a regional event. Claassen, J.P. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1985. Contract AC04-76DP00789. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86003792.

Inhomogeneities in the earth's crust produce scattering, multipathing, reverberation and mode conversion. The degree to which the signals are correlated is dependent on the geologic structure beneath the array, between the event and the array, and to some degree around the event. Since coherent beam formation requires replicated signals except for noise at each receiver, the diameter of seismic arrays must be restricted to spans over which the signals remain spatially coherent. If seismic arrays are to be important elements in a regional network that performs seismic verification functions for a Comprehensive Test Ban Treaty, the influence of crustal geology on seismic spatial coherence must be well understood. This report was written to (1) address problems in estimating the spatial coherence of seismic signals, (2) demonstrate a coherence estimator on a single event, (3) show how spatial coherence influences the performance of regional seismic arrays in a seismic verification context, and (4) establish parameters useful for designing arrays in geologic shields. Specifically, it is shown that the Blackman-Tukey spectral estimation method can be adapted in a straightforward way to estimate spatial coherence. The pitfalls in estimating spatial coherence are discussed and practical methods for abating their effects are introduced. The spatial coherence estimation theory is then applied to a single regional event that had been observed by the Norwegian Regional Seismic Array (NRSA) on the Fenno-Scandinavian shield. The distances over which the signals remain coherent are then inferred from the coherence estimates through an exponential model for spatial decorrelation. Correlation distances at various frequencies over a 1 to 20 Hz bandwidth for the four regional arrivals, P/sub n/, P/sub g/, S/sub n/, and L/sub g/, are identified. 9 refs., 41 figs., 11 tabs.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

7799 (DOE/NBM—6003517) National Acid Precipitation Assessment Program. Annual report 1984 to the President and Congress. (Interagency Task Force on Acid Precipitation, Washington, DC (USA)). 1984. 95p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86003517.

Highlights of accomplishments in the acid rain national research program during 1984 are summarized. Significant advances in the following areas are reported: natural sources, man-made sources, atmospheric processes, deposition monitoring, aquatic effects, terrestrial effects, effects on materials and cultural resources, control technologies, and assessments. A list of publications produced under the National Program are included and the outlook for continued research is discussed. (DMC)

5001 BASIC STUDIES

REFER ALSO TO CITATION(S) 7803

7800 (CONF-8510214—2) Results from a high power, high frequency sodar. Coulter, R.L.; Martin, T.J. (Argonne National Lab., IL (USA)). Oct 1985. Contract W-31-109-ENG-38. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003041.

From 3. international symposium on acoustic remote sensing of the atmosphere and oceans; Paris, France (14 Oct 1985).

The design and operation of a high power, portable minisodar operating at 3 to 7 kHz are described. Estimates of first and second moments of vertical velocity made using this system are presented and some field applications described. 3 refs., 6 figs., 1 tab. (ACR)

7801 (EUR—10171-EN) Measurement of precipitation by radar. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1985. 147p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

The main of the project COST-72 (Measurement of Precipitation by Radar) was, despite its name, to investigate the feasibility of a European weather radar network, taking into account the existing and planned national radars and radar networks, the needs of existing and potential data users, modern data processing equipment and techniques and means of telecommunication as well as the overall cost/benefit aspects of the activity in question. After six years of co-ordinated studies, experiments and planning, the Co-ordination Committee of the Project hereby issues its final report to the Committee of the Senior Officials of the EC.

7802 (LAPETH—26) Planetary boundary layer measurements over nonhomogeneous terrain: Data of the Reuss Valley Experiment 1982. Gygax, H.A.; Broder, B.; Tinguely, M. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Atmosphaerenphysik). 1985. 103p. NTIS (US Sales Only), PC A06/MF A01. File Number DE86750723.

The publication contains a short description of the geographic location of the experimental site and an overview of the measuring program. The instrumentation and measuring techniques are briefly described and an account is given of the treatment of the raw data. The data are classified using a stipulated scheme based upon several meteorological conditions and the nighttime behaviour of the ozone content. The data selected for further analysis are presented in the form of diagrams of daily variation of pertinent parameters. The publication concludes with a user's guide to the data which are available in a specially designed format on a computer tape.

5002 CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 6919, 6937, 6938, 7183, 7802, 7833

7803 (CONF-851155—2) Development of monthly emissions trends for recent years. Knudson, D. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004038.

From Annual emissions inventory symposium; Charleston, SC, USA (12 Nov 1985).

As atmospheric transport and deposition modeling capabilities increase and monitoring data are accumulated, it becomes desirable to also have representative emissions data. This paper describes the methodology and results of an effort to generate state-total source category-specific monthly SO_2 and NO/sub x/ emission estimates for the period 1975-1983. These data complement other data bases and support a variety of analytical efforts. The basis of the monthly emission estimates are source category-specific state-total SO_2 and NO/sub x/ emission values from the 1980 NAPAP emissions inventory. Annual emissions from the electric utility industry are allocated to monthly values using actual monthly fuel use for each year in the period. Annual emission values for other source groups were apportioned to monthly values using data which provides an indication of the monthly activity for each source group in the inventory year (1980). Annual state-total source category emission for other years in the period were derived from the EPA emissions trends data. The results indicate that intre-annual variability of SO_2 and NO/sub x/ emissions for each state depend on the variability of source categories contributing most to state total emissions. In states with SO_2 emissions dominated by the electric utility sector, maximum emissions occur in the summer and winter. The relative of these two peaks depend on such factors as climate and utility prime mover and fuel mix. Monthly NO/sub x/ emissions variations are also a function of the variability of source groups contributing the most to total state NO/sub x/ emissions. In all states, vehicle fuel consumption contributes substantially to total state NO/sub x/ emissions. Monthly variability of NO/sub x/ emissions attributable to this source category shows only small variability in most states.

7804 (CONF-860113—1) Forecasting transportation activity and emissions for the national acid precipitation assessment program. Saricks, C.L.; Vyas, A.D. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85018352.

From 65. annual meeting of the Transportation Research Board; Washington, DC, USA (20 Jan 1986).

Transportation sources of three acid rain precursor pollutants (oxides of nitrogen, or NO/sub x/; volatile organic compounds, or VOC, and sulfur dioxide, or SO_2) contribute significantly to their atmospheric loading. The main objectives of modeling these emissions for the 1985 National Acid Precipitation Assessment Program (NAPAP) are to (a) develop state-by-state projections of these precursor pollutants and (b) incorporate in the forecasting scheme the capability to model the effects of currently programmed and planned strategies on pollutant loading. The Transportation Energy and Emissions Modeling System (TEEMS) was used to develop the desired projections from NAPAP economic driver outputs. This system is a technology-based modeling package, the activity forecasting module of which has three major components: (a) a local personal-travel model, (b) an intercity passenger travel model, and (c) a freight activity projection model. The emissions module in TEEMS uses US EPA's MOBILE3 model and AP-42 factors to estimate state-level emissions from national data. Results from the NAPAP reference scenario indicate an increase in transportation activity at a rapid rate during 1985 to 2000, but at a slow rate during 2000 to 2030. Transportation VOC emissions will fall to 59% of their 1985 level by 2000 due to government emission regulation, but will increase after 2000. Emissions of NO/sub x/ will drop slightly, to 93% of the 1985 level by 1995, and then grow to 131% of the 1985 level by 2030. This rise is due to the lack of regulation for off-highway vehicles and to greatly increased activity by heavy diesel trucks. Emissions of SO_2 will continue to increase for the same reasons, augmented by the rise in sulfur content of residual fuel. 7 refs., 3 figs., 5 tabs.

7805 (CONF-8411220—1) Significance of elevated levels of ozone on natural ecosystems of North America. Taylor, G.E. Jr.; Norby, R.J. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002185.

From Air Pollution Control Association; Houston, TX, USA (29 Nov 1984).

This paper characterizes ozone (O_3) climatology in natural ecosystems of North America and discusses the consequences of sustained elevated O_3 levels on the physiology and growth of pollutant-sensitive forest trees, population genetic structure of sensitive species, forest community dynamics, and ecosystem structure and function. The analysis of O_3 air quality in the Shenandoah National park, a representative forested ecosystem in eastern North America, shows a mean 7-hr daylight O_3 concentration during the growing season ranging from 0.04 to 0.06 ppM, with month-specific patterns of O_3 episodes and respites. Ozone concentrations and temporal patterns of O_3 air quality in the Shenandoah are not equivalent to those in either pristine or urban landscapes. As an anthropogenic

stress influencing natural ecosystems, O_3 exhibits many unique ecological properties including high reactivity, rapid decomposition, ephemeral residence time in the ecosystem, and a widespread regional distribution. Because the theory and methods for addressing ecosystem responses to stress evolved from studies of acute localized perturbations, traditional ecological approaches may be unable to accurately evaluate ecosystem-level changes to chronic stresses whose effects are regional in scope. 48 refs., 10 figs., 2 tabs.

7806 **(CONF-8511110—5) Enhancement of the toxic vapor identification capability of portable sensors using pattern recognition techniques.** Stetter, J.R.; Rose, S.L.; Jurs, P.C.; Stull, J.O. (Argonne National Lab., IL (USA); Naval Research Lab., Washington, DC (USA). Chemistry Div.; Pennsylvania State Univ., University Park (USA). Dept. of Chemistry; Coast Guard, Washington, DC (USA). Office of Research and Development). 1985. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004048.

From JANNAF Safety and Environmental Protection Subcommittee meeting; Monterey, CA, USA (4 Nov 1985).

A portable instrument is being developed that can detect, identify, and warn US Coast Guard emergency response personnel of the presence of hazardous concentration of toxic gases and vapors. The toxic compounds are detected by an array of inexpensive, semiselective electrochemical sensors, and the complex output is analyzed using pattern recognition methods. The phototype device incorporates an array of four different electrochemical sensors, each of which can be operated in four different modes. The device thus obtains 16 channels of data for each chemical species present in the air sample. Pattern recognition analysis of these data can be used to determine the uniqueness of the information obtained for each of the 16 channels. A set of patterns for 22 gases and vapors detected with a chemical sensor array was examined. Results indicate that approximately half of the channels provide unique information and the data from 8 to 10 channels are sufficient to identify individual compounds.

7807 **(DOE/FC/10616—1965) Sulfur dioxide emission control by furnace injection of a dry sorbent.** Reese, J.; Kurucz, K. (Energy and Environmental Research Corp., Irvine, CA (USA)). Sep 1985. Contract AC18-84FC10616. 244p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86003856.

Furnace injection of dry calcium-based sorbents to reduce SO_2 emissions was evaluated on a 53.5 MW/sub e/ utility boiler firing North Dakota lignite. The objective of the evaluation was to determine the effects of sorbent injection on SO_2 reductions, boiler performance, and electrostatic precipitator performance. Testing was performed at the Otter Tail Power Company Hoot Lake Unit 2. The field evaluation was conducted over a 3-week period and consisted of a series of short-term tests lasting up to four hours to evaluate the effects of sorbent type, injection configurations, and sorbent feedrates. A long-term evaluation of 30 hours was performed to evaluate the effects of sorbent injection on boiler performance. The sorbents evaluated in this program were high-calcium and dolomitic pressure hydrated limes. Pressure hydrates have shown high reactivity in bench scale tests, and calcium utilizations of 40% have been obtained by the University of North Dakota Energy Research Center (UNDERC). Bulk quantities of high-calcium pressure hydrate are not normally available from the lime industry and a special production run was made for this program by the Western Lime and Cement Company. Sorbent was injected through existing access ports to minimize modifications to the boiler, and was fed to the boiler using a temporary sorbent handling and injection system. The results of this evaluation showed that furnace injection of dry sorbent can achieve SO_2 reductions of nearly 70% in a lignite boiler with minimal impacts on boiler performance, precipitator performance, or particulate emissions. Based on previous bench scale results, increased SO_2 reductions appear feasible by increasing sorbent reactivity through optimization of the commercial pressure hydration process. 16 refs., 59 figs., 14 tabs.

7808 **(DOE/FE/60181—158) Enhanced utilization of furnace injected calcium-based sorbents.** Weber, G.F.; Bobman, M.H.; Collings, M.E. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Nov 1985. Contract FC21-83FE60181. 17p. (CONF-8511113—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003205.

From 3. conference of fabric filter technology for coal-fired power plants; Scottsdale, AZ, USA (12 Nov 1985).

Simultaneous control of SO/sub x//NO/sub x/ emissions is under investigation at the University of North Dakota Energy Research Center (UNDERC). Process development work has been performed on both bench-scale and pilot-scale systems. Direct furnace injection of calcium-based sorbents is the SO_2 control technique under evaluation. Furnace injection tests have focused on the direct injection of pressure-hydrated lime followed by particulate collection in a baghouse operated at conventional temperatures, 145° to 300°F. Sulfur dioxide reduction as high as 80% has been observed for high-calcium pressure-hydrated lime (PHL) injected at a Ca/SO_2 mole ratio of 2.0 with all of the SO_2 capture occurring in the flue gas at temperatures exceeding 1400°F. Pilot-scale tests have shown that furnace injection of high-calcium PHL at a Ca/SO_2 ratio of 1.0 can result in 65% to 70% SO_2 capture if the baghouse is operated at ~160°F. Improved sorbent utilization has been observed both for high-calcium PHL and for additive enhanced high-calcium PHL at baghouse temperatures of 145° to 220°F. Of the 65% to 70% overall utilization, 45% to 50% of the sorbent was utilized in the flue gas stream and an additional 15% to 25% utilization occurred in the baghouse.

7809 **(EPRI-EA—4305-Vol.1) Feasibility and design of the massive aerometric tracer experiment (MATEX). Volume 1. Presentation of the MATEX design concept. Final report.** Hidy, G.M.; Hansen, D.A.; Bass, A. (Environmental Research and Technology, Inc., Newbury Park, CA (USA)). Nov 1985. 172p. Research Reports Center, Box 50490, Palo Alto, Ca 94303. File Number TI86920070.

The massive aerometric tracer experiment (MATEX) is conceived as a way of determining by direct measurement the contributions of different SO/sub x/ and NO/sub x/ sources to acidic deposition at receptors. The MATEX concept is based on source emission tracking by atmospheric tracers such as perfluorocarbons. The principal MATEX product would be empirical source-receptor relationships for eastern North America, with stated levels of uncertainty and a capability to estimate changes in deposition due to changes in emissions from existing sources. Although the study team found the MATEX concept to be feasible, the MATEX is considered a high-risk enterprise at present because of certain inherent limitations. The study team then developed a two-phase approach for conducting MATEX, with the second phase being the full-scale experiment. The first phase consists of seven relatively small-scale experiments to surmount the limitations and develop field proof of the MATEX concept. The first phase would require four years and about $25 million, while phase two could be completed in six years for roughly $200 million. The MATEX feasibility and design study is reported in three volumes: Volume 1 describes the design; Volume 2 summarizes the results of evaluating experimental alternatives and of supporting studies; and the unpublished third volume, a collection of documents, details the supporting studies. 29 refs., 19 figs., 8 tabs.

7810 **(EPRI-EA—4305-Vol.2) Feasibility and design of the massive aerometric tracer experiment (MATEX). Volume 2. Experimental alternatives and evaluation methodology: supporting studies. Final report.** Hidy, G.M.; Bass, A.; Hansen, D.A. (Environmental Research and Technology, Inc., Newbury Park, CA (USA)). Nov 1985. 434p. Research Reports Center, Box 50490, Palo Alto, Ca 94303. File Number TI86920071.

The massive aerometric tracer experiment (MATEX) is conceived as a way of determining by direct measurement the contributions of different SO/sub x/ and NO/sub x/ sources to acidic deposition at receptors. The MATEX concept is based on source emission tracking by atmospheric tracers such as perfluorocarbons. The principal MATEX product would be empirical source-receptor relationships for eastern North America, with stated levels of uncertainty and a capability to estimate changes in deposition due to

changes in emissions from existing sources. Although the study team found the MATEX concept to be feasible, the MATEX is considered a high-risk enterprise at present because of certain inherent limitations. The study team then developed a two-phase approach for conducting MATEX, with the second phase being the full-scale experiment. The first phase consists of seven relatively small-scale experiments to surmount the limitations and develop field proof of the MATEX concept. The first phase would require four years and about $25 million, while phase two could be completed in six years for roughly $200 million. The MATEX feasibility and design study is reported in three volumes: Volume 1 describes the design; Volume 2 summarizes the results of evaluating experimental alternatives and of supporting studies; and the unpublished third volume, a collection of documents, details the supporting studies. 69 refs., 148 figs., 60 tabs.

7811 **(EUR—9377) Programme for testing and selecting a reference method for black smoke measurement.** Clayton, P.; Davis, B.J. (Commission of the European Communities, Luxembourg). 1984. 55p. Commission of the European Communities, Luxembourg.

Three black smoke sampling instrument/reflectometer combinations have been tested at three sites in the United Kingdom to assess their suitability for adoption as the Reference Method with regard to the EEC Directive on Black Smoke and Sulphur Dioxide in the ambient atmosphere. The instruments were manufactured by AGL (United Kingdom), IHE (Belgium) and Environment S.A. (France). Various aspects of the method developed by the Organisation for Economic Cooperation and Development (OECD) method have been examined particularly in relation to the shape of the calibration curves. As a result of the investigations a recommended routine measuring procedure has been defined which specifies the minimum requirements for a method which does not comply with the reference method. Test procedures for checking compliance with the minimum requirements are given. Recommendations have been made regarding a Black Smoke Reference Method. All the instruments tested were found to be suitable for the routine measurement of black smoke but no instrument met the OECD specification exactly. However the UK and French samplers were found to be suitable for upgrading to reference method standard provided that modifications were made to their flow control and measurement systems.

7812 **(EUR—9378) Wind tunnel measurements of the inlet efficiency of four samplers of suspended particulate matter.** Barrett, C.F.; Ralph, M.O.; Upton, S.L. (Commission of the European Communities, Luxembourg). 1984. 73p. Commission of the European Communities, Luxembourg.

Measurements have been made of the inlet efficiency of four suspended particulate matter (SPM) samplers in a wind tunnel large enough for the relevant range of turbulent eddy sizes to be simulated. The measurements were made under contract to the Commission of the European Communities (DG XI) in connection with Council Directive 80/779/EEC on Sulphur Dioxide and Suspended Particulates. The samplers tested were: the LIS/P and GS050/3 samplers used by the Federal Republic of Germany, the ISTISAN sampler used by Italy, and an 8-stage Andersen non-viable impactor, without the preseparator, which is used to give information on particle size distribution. Monodisperse aerosols of uranine (sodium fluorescein) between 2.5 μm and 23.0 μm in aerodynamic diameter were used at wind speeds of 1, 3 and 7 m s^{-1}. High inlet efficiencies were found for all of the samplers at all particle sizes at a wind speed of 1 m s^{-1}. At the higher wind speeds the efficiencies fell with increasing particle diameter, the decline in efficiency with increasing particle size and wind speed being less pronounced for the LIS/P and GS050/3 samplers than for the ISTISAN and Andersen samplers.

7813 **(GKSS—85/E/18) Initialization of the Euler model MODIS with field data from the "EPRI plume model validation project".** Petersen, G.; Eppel, D.; Lautenschlager, M.; Mueller, A. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1985. 20p. (CONF-8504135—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE86900299.

From 15. international technical meeting on air pollution modeling and it's application; St. Louis, MO, USA (15 Apr 1985).

The program deck MODIS ("Moment DIstrubution") is designed to be used as operational tool for modelling the dispersion of a point source under general atmospheric conditions. The concentration distribution is determined by calculating its cross-wind moments on a vertical grid oriented in the main wind direction. The model contains a parametrization for horizontal and vertical diffusion coefficients based on a second order closure model. The Eulerian time scales, preliminarily determined by fitting measured plume cross sections, are confirmed by comparison with data from the EPRI plume model validation project. 8 refs., 9 figs.

7814 **(PNL-SA—13237) Changes in phosphorus smoke chemistry with environmental conditions.** McFadden, K.M.; Ligotke, M.W.; Garland, T.R.; Van Voris, P.; Schirmer, R.E. (Pacific Northwest Labs., Richland, WA (USA)). Sep 1985. Contract AC06-76RL01830. 21p. (CONF-8506216—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001768.

From Conference on obscuration and aerosol research; Edgewood, MD, USA (19 Jun 1985).

Physical and chemical characteristics of two phosphorus aerosols were measured under a limited number of environmental conditions. The exposures and measurements were performed in a wind tunnel under various humidities, wind speeds and, to a limited extent, aerosol ages. Temperature, another important environmental variable that may influence the chemical form of the aerosols, was not studied in this research program. Steady-state aerosols generated by combustion of red phosphorus/butyl rubber (RP/BR) and white phosphorus (WP) were suspended in a closed-loop wind tunnel to simulate the continuous-generation of these obscurants at Army field training sites. Measured aerosol characteristics were found to differ significantly from characteristics predicted by simple phosphoric acid models previously thought to represent the chemical form of the suspended particles. As many as 28 individual phosphorus species were detected in aerosol samples. The distribution of linear and cyclic phosphorus species in the sampled aerosol was observed to vary significantly for changes in both aerosol age (0 to 60 min) and relative humidity (<5% to 90%). Hydrolysis toward phosphate occurred as the aerosol aged, and the rate of change was slower for higher humidities. More high-order phosphorus species appeared to be formed during aerosol generation at low relative humidities than at high humidity, as revealed by measurements near the combustion zone. Steady-state aerosols showed decreasing conversion to phosphate with increasing humidity. The highly speciated aerosols hydrolyzed to phosphate in less than 18 hr after deposition onto dry surfaces. Other aerosol characteristics such as mass concentration, water and phosphorus content of the particles, and particle size distribution were also measured.

7815 **(PNL-SA—13359) Use of a toxic and hazardous aerosol research facility to evaluate fate and effects of Army smoke screen materials.** Van Voris, P.; Ligotke, M.W.; Cataldo, D.A.; McFadden, K.M.; Garland, T.R. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. Contract AC06-76RL01830. 7p. (CONF-8510151—14). NTIS, PC A02/MF A01; GPO Dep. File Number DE86004027.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

Aerosols are generated and injected into a new specialized wind tunnel that can reproduce a range of environmental conditions.The wind tunnel is part of the Toxic and Hazardous Aerosol Exposure Facility (T/HAEF) located at Pacific Northwest Laboratory on the Department of Energy's Hanford Site in Richland, Washington. The T/HAEF is designed for total containment (P-3 rated) and houses a sealed, negative pressure, recirculating wind tunnel, controlled environment chambers, microcomputer and an analytical support laboratory. The facility offers a unique ability to conduct aerosol research in a dynamic environment simulating natural field conditions. Wind speeds from 0.2 to 30.0 m/s (65 mph), temperatures between 0 and 45°C, and relative humidities from 20% to 95% with mist and rainfall simulation are controlled and programmable through the microcomputer system. The T/HAEF enables researchers to evaluate physical and chemical interactions along with biological and environmental fate and effects of

both aerosols and gases. Research currently being performed in this facility and presented in this paper evaluates the environmental fate and effects of various smokes used by the US Army throughout the United States to screen both troop and track vehicle movements during training. 6 refs., 3 figs., 2 tabs.

7816 **(UCRL—92482) Use of gas imaging as an emergency response tool.** McRae, T.G. (Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 9p. (CONF-8511110—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001907.

From JANNAF Safety and Environmental Protection Subcommittee meeting; Monterey, CA, USA (4 Nov 1985).

The Backscatter/Absorption Gas Imaging (BAGI) technique is a promising new concept for the location and tracking of hazardous gases. The fundamental principle of the technique is that if hazardous gases were visible to the human eye, it would be easy to locate the source of a leak or, in the case of an accidental spill, to determine the extent and direction of movement of the resulting vapor cloud. The ability to image these gases thus represents a very practical emergency response tool. The BAGI technique offers a simple way to accomplish these goals by integrating an infrared (IR) laser and an IR imaging system. An airborne BAGI system could be used to determine the location of hazardous gas clouds resulting from disabled vessels at sea, train derailments or tanker truck accidents. This real-time capability would provide valuable input for evacuation decisions facing emergency response teams. The BAGI technique shows promise as a long-range detection system capable of quickly locating the sources of hazardous gas and monitoring the dispersion clouds even at very low concentration levels. The system is simple to operate and interpret, and is composed of field-proven instruments which should make commercialization easy. 2 refs., 6 figs., 1 tab.

7817 **(CE-Trans—7589) Validity of the log-normal distribution of pollutant concentrations.** Benarie, M.M. (Central Electricity Generating Board, London (UK). Information Services). [1985]. Translation of Paper SU-18D, 1971. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86900136.

This report discusses the relationship between wind velocity in a given direction and the concentration of a pollutant emitted from a single source. At an urban site, polluted from a large number of sources, which may be considered as being random, the resulting distribution must be log-normal, because the distribution for each emission point, defined by the log-normality of wind velocities, are log-normal. This explanation contains an empirical element, because theoretical proof of wind log-normality is not available at the moment. In any case, it makes observations concerning pollution into a meteorological phenomenon.

5003 RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 7040, 7049, 8111

7818 **(BNL—37138) Data base to compare calculations and observations.** Tichler, J.L. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 17p. (CONF-8510231—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003371.

From 2. annual international SIR user group conference; Smokie, IL, USA (21 Oct 1985).

Meteorological and climatological data bases were compared with known tritium release points and diffusion calculations to determine if calculated concentrations could replace measure concentrations at the monitoring stations. Daily tritium concentrations were monitored at 8 stations and 16 possible receptors. Automated data retrieval strategies are listed. (PSB)

7819 **(LA—10546-PR) Stratospheric tritium sampling. Final progress report.** Mason, A.S.; Oestlund, H.G. (Los Alamos National Lab., NM (USA)). Sep 1985. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004368.

Stratospheric tritium sampling was part of Project Airstream (sponsored by the US Department of Energy) between 1975 and 1983. Data from the final deployment in November 1983 are reported here, and the results of the 9 years of effort are summarized. 9 refs., 2 figs., 2 tabs.

7820 **(RFP—3777) Continuous scanning in-situ high efficiency particulate air (HEPA) filter monitoring system.** Kirchner, K.N.; Johnson, C.M.; Aiken, W.F.; Lucerna, J.J.; Barnett, R.L. (Rockwell International Corp., Golden, CO (USA)). 1985. Contract AC04-76DP03533. 16p. (CONF-851082—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001262.

From European conference on gaseous effluent treatment in nuclear installations; Luxembourg, Luxembourg (14 Oct 1985).

The testing and replacement of HEPA filters, which are widely used in the nuclear industry to purify process air, is a costly and labor-intensive undertaking. Using current technology, a continual in-site monitoring system has been designed which provides three major improvements over current methods of filter testing and replacement. The improvements include: (1) cost savings by reducing the number of intact filters which are currently being replaced unnecessarily, (2) more accurate and quantitative measurement of filter performance, and (3) reduced personnel exposure to a radioactive environment by automatically performing most testing operations. An XYZ sample system was designed and constructed to transport a sample probe to any location on a filter bank. Three stepping motors, one for motion in each direction, are used to move the probe along the twin-rail and rack and pinion axes. A serial interface card distributes movement commands to the proper axis indexer cards and driver cards, which in turn supply power to the stepping motors. Lasers single-particle analysis was chosen as the most sensitive detection method for this monitoring system. A microprocessor is used as the central processing unit (CPU) for the target computer system. The target computer controls placement of the sample probe. It also acquires and analyzes the data obtained from the spectrometer. This sample system uses either ambient air or a generated aerosol to challenge the HEPA filters and scan the downstream face of the filters to detect leaks. The target computer then calculates the filter efficiency. 3 refs., 3 figs., 3 tabs.

7821 **(STEV-FBA—85-8) Radioactive materials in ashes from peat fired plants.** Erlandsson, B.; Hedvall, R. (Statens Energiverk, Stockholm (Sweden)). Nov 1984. 7p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE86700220.

Project Torv-Haelsa-Miljoe.

Measurements of the gamma radiation have been used for determination of radioactive materials in peat ashes from five Swedish heating plants. The results show that the amount of radioactive materials was almost the same in all samples. The concentration of ^{125}Sb, ^{137}Cs, ^{144}Cs and ^{155}Eu were in good conformity with the concentrations found in the environment. The ^{235}U-concentration was hardly possible to measure.

7822 **(STEV-FBA—85-9) Radon from peat ashes.** Rosen, B. (Statens Energiverk, Stockholm (Sweden)). Nov 1984. 13p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE86700221.

Project Torv-Haelsa-Miljoe.

Eleven peat ashes have been investigated by gamma spectroscopy. The contents of radionuclides and the radon production were determined. Only two ashes showed an radioactivity higher that the accepted norms for building materials.

5005 SITE RESOURCE AND USE STUDIES

7823 **(EUR—9164) 25. 1983 meteorological yearbook of Ispra.** Bollini, G.; Galva, A.; Gandino, C.; Porrati, E. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1984. 91p. (In English and Italian). Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg.

25th 1983 meteorological yearbook of Ispra. After a short description of the methods for measuring and elaborating atmospheric phenomena, many tables and graphs for the meteorological year 1983 are reported with English titles too. The measurements of solar irradiation are marked with the final hour following Italian winter time.

5006 REGULATIONS

REFER ALSO TO CITATION(S) 7403, 7811

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5102 CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 7836

5103 RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 7002, 7003, 7016, 7040, 7052, 7053, 7054, 7836, 7837

7824 **(CONF-830610—7) Nevada Applied Ecology Information Center: a review of technical information support provided to the Nevada Applied Ecology Group.** Fore, C.S.; Pfuderer, H.A. (Oak Ridge National Lab., TN (USA)). 1983. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003311.

From Nevada Applied Ecology Group transuranics (and associated radionuclides) information conference; Las Vegas, NV, USA (28 Jun 1983).

The Nevada Applied Ecology Information Center (NAEIC) was established in January 1972 to serve the needs of the Nevada Applied Ecology Group (NAEG) by identifying, collecting, analyzing, and disseminating technical information relevant to NAEG programs. Since its inception, the NAEIC has been active in providing specialized information support to NAEG staff in the following research areas: (1) environmental aspects of the transuranics; (2) historic literature (pre-1962) on plutonium and uranium; (3) cleanup and treatment of radioactively contaminated land; (4) bioenvironmental aspects of europium and rhodium; (5) NAEG contractor reports; and (6) uptake of radioactivity by food crops.

7825 **(EGG—10282-1083) Aerial radiological survey of the Byron Station and surrounding area, Byron, Illinois. Date of survey: April 1985.** (EG and G Energy Measurements, Inc., Las Vegas, NV (USA)). Jul 1985. Contract AC08-83NV10282. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004176.

An aerial gamma survey was conducted over the Byron Station, located 5 kilometers (3 miles) south of Byron, Illinois, during the period 11 April through 17 April 1985. The survey included a 260-square-kilometer (100-square-mile) area centered on the Station. A contour map of the terrestrial gamma exposure rate plus cosmic exposure rate at the 1-meter level was prepared and overlaid on an aerial photograph and a USGS topographic map of the area. The terrestrial plus cosmic gamma exposure rate ranged from a minimum of 5.0 microroentgens per hour (μR/h) over the Rock River to a maximum of 12 μR/h 7 kilometers (4 miles) west of the facility. A machine-aided search of the data showed no man-made gamma emitters in the survey area. Soil samples and ion chamber measurements were obtained at four locations to support the aerial data. 6 refs., 6 figs., 3 tabs.

7826 **Use of a commercial ranging system in field surveys of radioactively contaminated sites.** Worth, G.M.; Crowell, J.M.; Jarrett, J.D.; Meddles, A.D.; Moyer, C.; Umbarger, C.J.; Wolf, M.A. (Los Alamos National, Lab., Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 1, 957-960(Feb 1985). (CONF-841007—).

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

The adaptation of a commercial ranging and tracking system interfaced to these instruments and to an advanced computer graphics system promises another major improvement to the automation of data collection. Contour maps with radiation isopleths and the x-y position of up to eight instrument operators superimposed thereon can be displayed in near real time. A bidirectional data link offers a further improvement in simulation of, and training for, field surveys since previously collected or computer simulated radiation data as a function of position can be transmitted back to the same survey instrument and displayed to the operator in a manner indistinguishable from real-time data. Additionally, simulated instrument malfunctions such as low battery, detector failure, or total failure can be commanded to occur to evaluate operator response to unusual occurrences under the stress of field conditions. This training mode will greatly improve the ability to simulate situations and to train and evaluate operations personnel while eliminating the need to use special sites and potentially hazardous contamination simulants as are used now.

7827 **A multipurpose radiac for field surveys and training.** Wolf, M.A.; Bjarke, G.O.; Jarrett, J.B.; Umbarger, C.J. (Los Alamos National Lab., Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: No. 1, 964-966(Feb 1985). (CONF-841007—).

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

The Instrument Technologies Group at Los Alamos has developed a multipurpose radiac. It uses a variety of detectors coupled with a CMOS microprocessor to provide ease of use and an unambiguous display. It allows concurrent surveys for alpha, beta, gamma, and neutron radiation. In addition, it has an external data link for coupling to and from data acquisition/storage equipment, hence making it a perfect training tool. The instrument is small (4x8x2.5 in.) and lightweight (<2 lbs.). It runs for 50 hours on common batteries.

5105 SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 6997, 6998, 7418

7828 **(DES—74-94) Facility location evaluation for Shelton-Kitsap 230-kV line, Study Area 75-4. Draft supplement to the environmental statement, fiscal year 1976 proposed program.** (Bonneville Power Administration, Portland, OR (USA)). 22 Oct 1974. 57p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86003505.

This report discusses alternative route locations for the proposed construction of a 31.6-mile, 230-kV transmission line from Shelton, Washington, to Kitsap Substation near Port Orchard, Washington. The new line would replace an existing 115-kV woodpole line for 28.8 miles and has the potential to replace or parallel for 2.8 miles. Approximately 22.6 miles of commercial Christmas trees growing on the existing right-of-way will be removed during the construction of this facility. Depending on the alternative chosen, for the last 2.8 miles, increased right-of-way width could require from 9 to 24 acres of additional tree cover, primarily Douglas-fir. Alternatives considered are: (1) nonconstruction, and (2) replacement of existing 115-kV wood-pole line with replacement and parallel alternatives for the last 2.8 miles. Generation alternatives to all transmission construction, including alternative methods of electrical transmission and generation, transmission construction, disposal of slash and limiting the consumption of electricity, are discussed in BPA's General Construction and Maintenance Program Statement and the Annual Proposed Program Environmental Statement.

7829 **(DES—75-9) Satsop integrating transmission. Supplement to the environmental statement, fiscal year 1976 proposed program.** (Bonneville Power Administration, Portland, OR (USA)). 1976. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86003506.

Alternatives were discussed for the proposed construction of a substation near Satsop and two 500-kV transmission lines from the proposed Satsop Substation approximately 24 miles west of Olympia, one running from Satsop to Paul Substation and one running from Satsop to Olympia Substation. Depending on the final route location chosen, between approximately 62 and 73 miles of 500-kV transmission line between the proposed Satsop Substation and Olympia and Paul Substations over existing, parallel, and new right-of-way would be required. Between 15 and 31 miles of new access road would also be required. Land use affected would include clearing from 560 to 1180 acres of timber. Depending upon the route location chosen, between 1/4 and 4 acres of agricultural land would be removed from production, and between 4 and 37 acres temporarily disrupted. In addition, approximately 30 acres of land would be required for the substation. Other impacts would include the removal of wildlife habitat associated with the above mentioned right-of-way requirements. Disturbance to wildlife during construction would occur. Some erosion and sedimentation would occur. Visual impacts would result from clearing rights-of-way through heavily forested areas. Noise and other disturbances to residents will occur, primarily during construction. The alternatives considered include: (1) nonconstruction, and (2) six alternative route locations for the proposed transmission lines. Generation alternatives to all transmission construction, including alternative methods of electrical transmission and generation, transmission construction, disposal of slash and limiting the consumption of electricity are discussed in BPA's General Construction and Maintenance Program Statement and the Annual Proposed Program Statement.

5106 REGULATIONS

7830 (DOE/PE/72005—T1) Environmental program audit, Paducah Gaseous Diffusion Plant, Paducah, Kentucky. Final report. (NUS Corp., Gaithersburg, MD (USA)). Aug 1985. Contract AC01-84PE72005. 140p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86003834.

The environmental monitoring program, environmental control equipment and its use, and the facility's compliance with DOE orders, Federal and State laws and regulations were evaluated in this audit. No imminent threat to public health and safety was discovered. A needed quality assurance program is being added. Recommendations are given. (PSB)

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 BASIC STUDIES

7831 (DOE/ER/60311—1) Nutrient recycling on the southeastern US continental shelf, March 1, 1985-November 30, 1985. Hanson, R.B. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 1985. Contract FG09-85ER60311. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003918.

The southeastern US Coastal Boundary Zone (CBZ) is characterized by extensive salt marshes and rivers, physical processes near tidal inlets, coastal front(s), and seasonal conditions that force water circulation along the coast or across the shelf. The high phytoplankton carrying capacity of CBZ is presumably due to estuaries and rivers that exchange waters (nitrogen) with the CBZ. Our research addresses the hypothesis that the CBZ is a regenerative system and microbial recycling of "old" nitrogen supports the high rates of primary production off the southeastern US coast. We investigated how water circulation patterns in the spring (SPREX 1985) affects biological transformations and transport of nitrogen across the southeastern US continental shelf. Our research focused on NH_4^+ regeneration using isotopic tracer (^{15}N) techniques to assess nitrogen recycling. 3 figs., 10 tabs.

7832 (DOE/EV/00639—27) Production and turnover of suspended organic detritus in the coastal water of the southeastern continental shelf. Progress report, June 1, 1985-May 31, 1986. Pomeroy, L.R. (Georgia Univ., Athens (USA). Inst. of Ecology). 1 Dec 1985. Contract AS09-76EV00639. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003739.

Data from the April, 1985 SPREX study, and various asects of the ongoing BIOTRANS program have been processed. SPREX, a two-ship study of spring removal of water from the coastal boundary zone, included measurements of respiratory rate and abundance of microorganisms during and following a spring storm event on the continental shelf. As part of the BIOTRANS program biological studies have been conducted on the coastal boundary zone off the southeast US coast. These studies include microbial respiration, production of bacterial aggregates and other organic detritus, and fallout and suspension from the bottom in response to waves and tides. These efforts involve a combination of field studies and experimental laboratory work, including laboratory studies of the formation of bacterial aggregates and the effects of suppression of various populations: protozoa, bacteria, and zooplankton; laboratory studies of resuspension of particulate detritus and benthic bacteria from sediments collected with box cores, using a 2-meter annular flume; and measurement of microbial respiratory rate in samples of unmodified ocean water, rapidly, aboard ship, using a newly designed respirometer system. (10 refs., 22 figs., 2 tabs.

5202 CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 7836, 7838

7833 (CONF-8511110—4) Products of the neutralization of hydrazine fuels with hypochlorite. Brubaker, K.L.; Stetter, J.R.; Demirgian, J.C.; Boparai, A.; Schneider, J.F. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004049.

From JANNAF Safety and Environmental Protection Subcommittee meeting; Monterey, CA, USA (4 Nov 1985).

Neutralization of hydrazine fuels with hypochlorite is a recommended procedure for treatment of fuel spills. Earlier publications have reported some of the major reaction products and have suggested that incomplete reaction and reaction with impurities may lead to formation of environmentally and toxicologically significant substances. The results presented in this paper were obtained as part of a program to assess the environmental implications of using the hypochlorite method for treatment and disposal of hydrazine fuel spills. The fuel sample impurities analyzed, the analytical protocols used, and the chemical compounds produced by neutralization of hydrazine fuels with hypochlorite are discussed. The fuels examined were hydrazine, monomethylhydrazine, unsymmetrical dimethylhydrazine, and Aerozine-50. The neutralization products were determined under experimental conditions comparable to those expected for actual spills. Major products, as well as environmentally significant minor products, were identified using gas-chromatography/mass-spectrometry and gas-chromatography/Fourier-transform-infrared-spectroscopy.

7834 (NP—6770049) Occurrence and behaviour of heavy metals and pesticides in the entrance of water from Danube and Rhine. Schwer, A.D. (Muenchen Univ. (Germany, F.R.). Fachbereich Tiermedizin). 29 Jul 1983. 150p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE86770049.

Water and fish have been examined as to their content of the heavy metals mercury, lead and cadmium and of certain polluting chemicals such as pesticides and PCBs. Heavy metals are declining in all rivers and lakes. In the Rhine, pesticides have decreased in recent years, but not PCBs. As far as the sediments of the Rhine are concerned, there is a general decrease of the content of heavy metals in the Upper Rhine. As to the rivers and lakes of Southern Bavaria, the amount of mercury found in fish can in general be regarded as unobjectionable. Only in animals from banked-up water

of the Danube mercury can be found in higher quantities. The residues of lead in fish have clearly diminished, but, just like those of cadmium, they still reach values in some places that make it advisable to limit the eating of these fish by man. The residues of pesticides in fish are generally declining. The PCBs show little tendency to decrease. Most of the examined fish, it is true, showed values that were, on an average, below the maximum limit of 5 mg/kg, but again and again single high values (up to 17 mg/kg) occurred. This is mainly true of the fish population of the Danube.

7835 **(NP—6770050) 15th report of the Arbeitsgemeinschaft Wasserwerke Bodensee-Rhein. The results of physical, chemical, biological and bacteriological studies of 1983.** (Arbeitsgemeinschaft Wasserwerke Bodensee-Rhein, Karlsruhe (Germany, F.R.)). 1983. 207p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE86770050.

The report presents the results of physical, chemical, biological and bacteriological studies carried out in 1983 on Lake Constance and its inlets, and on the Rhine. One studied predominantly the organic, salt and chlorine content of the waters. In addition the criteria for the biological self-purification of the waters were investigated.

5203 RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 6989, 7040, 7041, 7042, 7049

7836 **(BNL—37206) Microbial transformations of natural organic compounds and radionuclides in subsurface environments.** Francis, A.J. (Brookhaven National Lab., Upton, NY (USA)). Oct 1985. Contract AC02-76CH00016. 13p. (CONF-8506191—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003631.

From Workshop on effects of natural organic compounds and of microorganisms and radionuclide transport; Paris, France (11 Jun 1985).

A major national concern in the subsurface disposal of energy wastes is the contamination of ground and surface waters by waste leachates containing radionuclides, toxic metals, and organic compounds. Microorganisms play an important role in the transformation of organic compounds, radionuclides, and toxic metals present in the waste and affect their mobility in subsurface environments. Microbial processes involved in dissolution, mobilization, and immobilization of toxic metals under aerobic and anaerobic conditions are briefly reviewed. Metal complexing agents and several organic acids produced by microbial action affect mobilization of radionuclides and toxic metals in subsurface environments. Information on the persistence of and biodegradation rates of synthetic as well as microbiologically produced complexing agents is scarce but important in determining the mobility of metal organic complexes in subsoils. Several gaps in knowledge in the area of microbial transformation of naturally occurring organics, radionuclides, and toxic metals have been identified, and further basic research has been suggested. 31 refs., 1 fig., 3 tabs.

7837 **(CONF-8511127—1) Environmental impact of a teratogenic actinide: a case study of americium-241.** Wang, J.; Yang, J.Y. (Argonne National Lab., IL (USA); Camp Dresser and McKee, Inc., Chicago, IL (USA)). 16 Oct 1985. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86001795.

From Conference on technology and science; Newton, MA, USA (29 Nov 1985).

Americium-241 is widely used as a radiation source, but it also has some potential risk if taken into the body. Although the radiotoxicity of americium-241 is small compared to other transuranic actinides, its effects on the reproductive system and on development of the placenta are more damaging than the effects of plutonium-239. A previous report based on a worst-case scenario involving a hypothetical fire accident in a contaminated facility indicated that there could have been a significant impact on nearby residents from a unit release of americium-241 via atmospheric dispersion. However, because the facility is located in a rural region where most drinking water supplies are drawn from private wells, it is believed that deposition of americium-241 from the atmosphere might also have impacts via the groundwater pathway by infiltration of rainwater. In this analysis, a three-dimensional analytical mathematical model is used to assess several aspects of americium-241 contamination of groundwater, including radioactive transformation, advection, dispersion, and soil sorption. Simulation results indicate that no significant radiological impacts would occur to the nearby residents via the groundwater pathway. 15 refs., 2 figs., 2 tabs.

7838 **(PNL—5408) Ground-water monitoring at the Hanford Site, January-December 1984.** Cline, C.S.; Rieger, J.T.; Raymond, J.R. (Pacific Northwest Labs., Richland, WA (USA)). 1985. Contract AC06-76RL01830. 205p. NTIS, PC A10/MF A01; GPO Dep. File Number DE86002296.

This program is designed to evaluate existing and potential pathways of exposure to radioactivity and hazardous chemicals from site operations. This document contains an evaluation of data collected during CY 1984. During 1984, 339 monitoring wells were sampled at various times for radioactive and nonradioactive constituents. Two of these constituents, specifically, tritium and nitrate, have been selected for detailed discussion in this report. Tritium and nitrate in the primary plumes originating from the 200 Areas continue to move generally eastward toward the Columbia River in the direction of ground-water flow. The movement within these plumes is indicated by changes in trends within the analytical data from the monitoring wells. No discernible impact on ground water has yet been observed from the start-up of the PUREX plant in December 1983. The shape of the present tritium plume is similar to those described in previous ground-water monitoring reports, although slight changes on the outer edges have been noted. Radiological impacts from two potential pathways for radionuclide transport in ground water to the environment are discussed in this report. The pathways are: (1) human consumption of ground water from onsite wells, and (2) seepage of ground water into the Columbia River. Concentrations of tritium in spring samples that were collected and analyzed in 1983, and in wells sampled adjacent to the Columbia River in 1984 confirmed that constituents in the ground water are entering the river via springs and subsurface flow. The primary areas where radionuclides enter the Columbia River via ground-water flow are the 100-N and 300 Areas and the shoreline adjacent to the Hanford Townsite. 44 refs., 25 figs., 11 tabs.

5205 SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 6998, 7086, 7087

7839 **(DOE/BP/12910—1) White River Falls Fish Passage Project, Tygh Valley, Oregon. Volume I. Final technical report .** (Oregon Dept. of Fish and Wildlife, Corvallis (USA); Forest Service, Mount Hood-Parkdale, OR (USA). Mount Hood National Forest; Ott Water Engineers, Inc., Bellevue, WA (USA); Buell and Associates, Inc., Beaverton, OR (USA)). Jun 1985. Contract AI79-84BP12910. 133p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86003967.

Studies were conducted to describe current habitat conditions in the White River basin above White River Falls and to evaluate the potential to produce anadromous fish. An inventory of spawning and rearing habitats, irrigation diversions, and enhancement opportunities for anadromous fish in the White River drainage was conducted. Survival of juvenile fish at White River Falls was estimated by releasing juvenile chinook and steelhead above the falls during high and low flow periods and recapturing them below the falls in 1983 and 1984. Four alternatives to provide upstream passage for adult salmon and steelhead were developed to a predesign level. The cost of adult passage and the estimated run size of anadromous fish were used to determine the benefit/cost ratio of the preferred alternative. Possible effects of the introduction of anadromous fish on resident fish and on nearby Oak Springs Hatchery were evaluated. This included an inventory of resident species, a genetic study of native rainbow, and the identification of fish diseases in the basin. 28 figs., 23 tabs.

7840 **(DOE/BP/12910—3) White River Falls Fish Passage Project, Tygh Valley, Oregon. Volume III: Appendix B, fisheries report; Appendix C, engineering alternative evaluation; Appendix D, benefit/cost analysis. Final technical report.** (Oregon Dept. of Fish and Wildlife, Corvallis (USA); Ott Water Engineers, Inc., Bellevue, WA (USA); Buell and Associates, Inc., Beaverton, OR (USA)). Jun 1985. Contract AI79-84BP12910. 251p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86003968.

Studies were conducted to describe current habitat conditions in the White River basin above White River Falls and to evaluate the potential to produce anadromous fish. An inventory of spawning and rearing habitats, irrigation diversions, and enhancement opportunities for anadromous fish in the White River drainage was conducted. Survival of juvenile fish at White River Falls was estimated by releasing juvenile chinook and steelhead above the falls during high and low flow periods and recapturing them below the falls in 1983 and 1984. Four alternatives to provide upstream passage for adult salmon and steelhead were developd to a predesign level. The cost of adult passage and the estimated run size of anadromous fish were used to determine the benefit/cost of the preferred alternative. Possible effects of the introduction of anadromous fish on resident fish and on nearby Oak Springs Hatchery were evaluated. This included an inventory of resident species, a genetic study of native rainbow, and the identification of fish diseases in the basin. This volume contains appendices of habitat survey data, potential production, resident fish population data, upstream passage designs, and benefit/cost calculations. (ACR)

7841 **(SREL—18) Aspects of organic matter transport and processing within Savannah River Plant streams and the Savannah River flood plain swamp.** Hauer, F.R. (Savannah River Ecology Lab., Aiken, SC (USA)). Jun 1985. Contract AC09-76SR00819. 197p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86003902.

The studies were directed toward understanding; (1) the transport dynamics, storage, and retention of organic matter, (2) the processing of leaf material that enters the streams and swamp habitats of the SRP, and (3) how these factors are influenced by current or previous reactor operations at the SRP. Suspended particulate organic matter, benthic organic matter, and in-stream wood were investigated along selected reaches of Steel Creek from April 1983 to April 1984. Concentrations of organic seston ranged from 0.4 to 5.7 mg l^{-1}. Steel Creek transported significantly higher concentrations of particulate organic matter than did either Meyers Branch or the waters at the swamp site. Seston and dissolved organic matter were investigated on Four Mile Creek, a thermal stream on the SRP, within three different reactor cycles; reactor not operating (cold flow), reactor operating in early portion of cycle (early hot flow), and reactor operating in late portion of cycle (late hot flow). Significantly higher concentrations of particulate organic matter were transported at all study sites during hot flow than during cold flow. Particulate organic matter and dissolved organic matter concentrations were investigated at twelve sampling sites to quantify input and output dynamics of organic matter to the flood plain swamp. Samples were taken biweekly from February 1983 to March 1984. Dissolved organic matter concentrations ranged from 1.3 to 9.9 mg l^{-1} and particulate organic matter concentrations ranged from 0.3 to 5.1 mg l^{-1}. Leaf decomposition of three bottomland tree species was studied at six stream and four swamp sites under various temperature regimes.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 BEHAVIORAL BIOLOGY

7842 **Behavior and substrate selection during larval settling in the lobster Homarus americanus.** Botero, L.; Atema, J. *Journal of Crustacean Biology;* 2: No. 1, 59-69(Feb 1982). Contract AC02-76EV02546.

During the molt from third- to fourth-stage, larvae of Homarus americanus metamorphose into their adult form and pigmentation. In the course of the fourth stage, their pelagic life changes to a benthic existence. Artificial substrate choice experiments and qualitative illumination experiments show that during the early fourth stage the phototactic response reverses from positive to negative. Together with positive thigmotaxis, this results in a choice of dark crevices. Among natural substrate choices, preferential settlement occurred on macroalgal-covered rocks, followed by rocks on sand, mud, and sand. Although mud was not a preferred substrate in choice tests, the animals that chose mud and those that were presented only with mud settled successfully and were immediately efficient in their burrowing behavior, constructing U-shaped tunnels even in the center of the aquarium without using a pebble or rock as a starting point. These laboratory test confirm field observations that lobsters can successfuily exploit a variety of substrates. They show that a substrate with preformed crevices is preferred for settling, but other substrates can be manipulated to make suitable burrows.

5502 BIOCHEMISTRY

REFER ALSO TO CITATION(S) 7098, 7854, 7867

7843 **(DOE/ER/10683—6) Genetics and biochemistry of biosurfactant synthesis in Arthrobacter species H-13-A. Progress report.** Finnerty, W.R. (Georgia Univ., Athens (USA). Research Foundation). Oct 1985. Contract AS09-80ER10683. 64p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86003564.

A number of microorganisms produce biosurfactants or bioemulsifiers. The chemical and physical properties of these molecules are poorly understood. Biosurfactants compare favorably and, in some cases, are superior to synthetic surfactants. Petroleum sulfonates are commonly used today in surfactant flooding processes for enhanced oil recovery. The biosynthetic pathway for several simple glycolipid-type biosurfactants has been described. The role of these molecules in the uptake or transport of water-insoluble substrates, such as alkanes, has not been firmly established. We propose to study the biosynthesis of glycolipopeptide by Arthrobacter sp H-13-A, focusing on completion of glycolipoprotein structure analysis; elucidation of enzymes involved in glycolipopeptide biosynthesis; and optimization of transformation frequencies for the recombinant shuttle vector constructed for Arthrobacter sp H-13-A with isolation of DNA sequences encoding extracellular glycolipopeptide synthesis. 67 refs., 1 fig., 16 tabs.

7844 **(DOE/ER/13278—1) Detection and characterization of novel metal-binding proteins. First year report, 1984-1985.** Holmes, D.S.; Unterman, R.D. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). Nov 1985. Contract FG02-84ER13278. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003749.

We have synthesized several model peptides based on the metallothionein (MT) protein sequence, and have used these, in conjunction with several naturally occurring proteins, to evaluate current methodologies for isolating and characterizing metal-binding proteins. Our off-contract research has indicated that High Pressure Liquid chromatography (HPLC) offers several distinct advantages compared to other techniques in this area. In addition, we have developed improved on-linc analysis for the detection of sulfhydryl-containing proteins that have been separated by HPLC. 12 figs., 2 tabs.

7845 **(DOE/ER/13339—1) Respiratory enzymes of Thiobacillus ferrooxidans. Progress report, March 1985-November 1985.** Blake, R. II. (Meharry Medical Coll., Nashville (USA). Dept. of Biochemistry). 1985. Contract FG05-85ER13339. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003849.

Rusticyanin was purified from bacterial paste derived from thiobacillus ferrooxidans. Detailed kinetic data on one-electron transfer reduction of rusticyanin using stopped-flow spectrometry. (DT)

7846 (DOE/ER/13352—T1) Characterization of plant plasma membrane antigens. Progress report. (Nebraska Univ., Lincoln (USA)). 1985. Contract FG02-85ER13352. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003433.

Monoclonal antibodies directed towards antigens derived from Nicotiana tabacum are being screened. (DT)

7847 (DOE/OR/21400—T209) Modern instrumentation: a challenge for the reference system for clinical enzymology. Burtis, C.A. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003303.

With the advent of the development and availability of reference methods and enzyme reference materials in the late 1970s, there has been a shift from component calibration to one of calibration of the entire measurement system. In this approach, high quality enzyme materials are used as primary reference materials to calibrate reference methods (RM). The RM is used in turn to produce secondary reference materials with assigned values which are then used to calibrate the analytical systems that are routinely used in the laboratory. By calibrating the system with a material having a single assigned value, bias arising from instrumental sources or methodological differences can be compensated for by electronic adjustment. New analytical systems that incorporate state-of-the-art technology which are highly automated and reliable have also been recently introduced. These instruments are calibrated as a system and will maintain their calibration for long periods of time. By calibrating these highly integrated, stable systems with secondary enzyme reference materials that are traceable back to the primary enzyme reference material, the opportunity to implement a reference system for enzyme measurements comparable to what has been established for the more definable analytes is now available. 51 refs., 6 figs., 5 tabs.

7848 Dietary effects on lipid and fatty acid composition of Clistoronia magnifica (Trichoptera: Limnephilidae). Hanson, B.J.; Cummins, K.W.; Cargill, A.S. II; Lowry, R.R. (Oregon State Univ., Corvallis). *Freshwater Invertebrate Biology;* **2**: No. 1, 2-15(Feb 1983). Contract AT06-79EV10004.

Dietary influences on growth and biochemical composition of the caddisfly Clistoronia magnifica were examined with a variety of diets including wheat, microbially conditioned alder, and wheat plus alder. Larvae receiving wheat were able to override direct temperature effects, while those on alder could not. Based on larval growth rates, and pupal weights and lipid contents, the authors concluded that alder alone was a poor quality food for late instar C. magnifica. A diet of alder plus wheat allowed the most growth, and produced the largest pupae, however pupae from larvae given just wheat had the largest lipid stores. Among-treatment differences in protein and lipid content, and fatty acid composition verified the importance of fatty acids synthesized from dietary carbohydrate. It appears that a carbohydrate source for the metabolism of storage lipid is a major requirement for late instar C. magnifica.

5503 CYTOLOGY

7849 (LA-UR—85-3634) Karyotypic evolution during neoplastic progression in nude mice. Kraemer, P.M.; Campbell, E.W.; Cooper, J.L.; Stallings, R.; Wharton, W. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 15p. (CONF-8510199—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002415.

From 5. international workshop on immune-deficient animals; Copenhagen, Denmark (13 Oct 1985).

When tumorigenic cultured cell populations are inoculated into nude mice, the tumorigenic process generally requires further progression and selection in vivo. This in vivo progression should be reflected in the altered properties of the tumor cells, as compared to the cells implanted. Karyotypic instability was studied during this process. 6 refs., 5 figs.

7850 (LBL—18393, pp 157-159) Active site of proton transport in purple membrane. Jap, B.K.; Scherrer, P.; Glaeser, R.M. Apr 1985. NTIS, PC A12/MF A01. File Number DE85010638.

In Biology and Medicine Division annual report, 1983-1984.

DCCD (dicyclohedylcarbodiimide), a small, highly hydrophobic organic molecule, is well known to inhibit the proton and ion transport of a variety of membrane proteins. Because of its hydrophobic nature, DCCD reaction is limited to carboxyl residues embedded in the lipid bilayer. Preliminary results of efforts to locate the reaction site or sites of DCCD are described. The location of the reaction site(s) will provide information about the active site of proton pumping and give constraints for the packing of the primary sequence in the lipid bilayer, thereby providing a means to test the existing models.

7851 Quantitative cytokinetics: cellular response to cell cycle specific agents. Gray, J.W. (Univ. of California, Livermore). *Pharmacology and Therapeutics;* **22**: 163-197(1983). Contract W-7405-ENG-48.

The importance of the cell cycle traverse (cytokinetic) properties of normal and tumor cell populations in the development of anticancer strategies has been studied and debated for over twenty years. The potential for the improvement of cancer therapy schedules using cytokinetic principles is great: especially as newly developed techniques are applied to the collection of increasingly accurate cytokinetic information. In the studies reviewed here, the authors illustrate the magnitude of the therapeutic potential of cytokinetics, review classical and recent cytokinetic techniques to illustrate technical advances that promise to substantially increase the quality and quantity of cytokinetic information, and suggest areas for further development.

5505 METABOLISM

REFER ALSO TO CITATION(S) 7861

5506 MEDICINE

REFER ALSO TO CITATION(S) 7871

7852 (ORNL/TM—9707) Nuclear medicine progress report for quarter ending June 30, 1985. Knapp, F.F. Jr.; Ambrose, K.R.; Goodman, M.M.; Srivastava, P.C. (Oak Ridge National Lab., TN (USA)). Oct 1985. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002557.

The subcellular distribution and lipid analysis studies of the 3-monomethyl-branched (BMIPP), 3,3-dimethyl-branched (DMIPP), and the parent straight-chain 15-para-iodophenylpentadecanoic acid (IPP) are described. Because of the observed differences of the relative myocardial uptake and retention of these agents in fasted and nonfasted rats, a detailed evaluation of the subcellular distribution profiles and the distribution of radioactivity within various lipid pools extracted from cell components was performed. The dimethyl DMIPP analogue showed the longest retention and also showed the highest association with the mitochondrial and microsomal fractions. The 3-monomethyl (BMIPP) analogue appeared to undergo slower oxidation than the straight chain (IPP), and the dimethyl-branched (DMIPP) analogue was apparently not oxidized by the myocardium. All three analogues showed some incorporation into triglycerides. Because the positron emitting radioisotopes of bromine show good radionuclidic properties, a new [^{82}Br]-labeled bromopentenyl-substituted cation was prepared. The tissue distribution of triphenyl-(E,Z-[^{82}Br]bromopenten-5-yl)phosphonium iodide in rats showed high heart uptake and retention with high heart to blood ratios. Radioiodinated (E)-2-C-iodovinyl-D-glucose has been prepared as a new iodovinyl-substituted carbohydrate containing C-iodovinyl-branching at the 2-position. 5 refs., 11 figs., 2 tabs.

5507 MICROBIOLOGY

REFER ALSO TO CITATION(S) 7843

7853 Regulation of nitrogen fixation in Rhodospirillum rubrum grown under dark, fermentative conditions. Schultz, J.E.; Gotto, J.W.; Weaver, P.F.; Yoch, D.C. (Solar Energy Research Institute, Golden, CO). *Journal of Bacteriology;* **162**: No. 3, 1322-1324(Jun 1985).

Rhodospirillum rubrum was shown to grow fermentatively on fructose with N_2 as a nitrogen source. The nitrogenase activity of these cells was regulated by the NH_4^+ switch-off/switch-on mechanism in a manner identical to that for photosynthetically grown cells. In vitro, the inactive nitrogenase Fe protein from fermenting cells was reactivated by an endogenous membrane-bound, Mn^{2+}-dependent activating enzyme that was interchangeable with the activating enzyme isolated from photosynthetic membranes.

5509 PATHOLOGY

7854 (DOE/ER/60203—T1) Experimental investigations with radiolabeled anti-collagen antibody. Gottschalk, A. (Yale Univ., New Haven, CT (USA). School of Medicine). [1986]. Contract AC02-84ER60203. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86004090.

Antibodies to collagen were prepared and labelled with indium 111. Kinetic studies were performed using labelled antibody for up to 48 hours following an injury. These results provide a method to detect injury by radioimmunographic techniques. 5 figs., 3 tabs.

7855 Pathogenesis of acute and chronic lung injury induced by foreign compounds. Witschi, H.P.; Lindenschmidt, R.C. (Oak Ridge National Lab., TN). *Clinical Physiology and Biochemistry;* No. 2-3, 135-146(1985).

The lung may become damaged by both airborne or bloodborne agents. Mechanisms implicated in the pathogenesis of lung injury include formation of highly reactive metabolites formed by pulmonary mixed function oxidases or formation of free oxygen radicals. Acute and chronic damage can be evaluated by several methods, such as histology and quantitative morphometry, non-invasive and non-destructive respiratory function tests, and with biochemical techniques that include measuring lavage enzyme levels or quantitating the presence of macromolecules such as collagen. In addition, cell kinetics provide an additional method to explore events following lung damage. 34 references.

5530 AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 7839, 7840

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 RADIATION EFFECTS

REFER ALSO TO CITATION(S) 7857, 7859

7856 (LBL—18393, pp 109-114) **Tumor radiobiology studies with heavy-charged-particle beams.** Curtis, S.B.; Tenforde, T.S.; Afzal, S.M.J.; Montoya, V.; Parr, S.; Carr, B. Apr 1985. NTIS, PC A12/MF A01. File Number DE85010638.

In Biology and Medicine Division annual report, 1983-1984.

The response of a rat rhabdomyosarcoma tumor system to irradiation with heavy charged particles is being evaluated from experiments conducted both in vivo and in vitro. The radiobiological end points studied include tumor volume response, cellular survival after tumor irradiation in situ, and cell-kinetic parameters measured by fluorocytometry. The primary emphasis of research during the past year has been in the following areas: (1) repair of potentially lethal damage, (2) tumor repopulation kinetics following high- and low-LET radiation, and (3) measurements of interaction between high- and low-LET radiation damage. The results obtained in each of these areas are described.

7857 (LMF—112) Human radiation exposures related to nuclear weapons industries. Cuddihy, R.G.; Newton, G.J. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA). Inhalation Toxicology Research Inst.). Sep 1985. Contract AC04-76EV01013. 171p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86004188.

A review is presented of radiation exposures resulting from American nuclear weapons test, nuclear weapons fabrication and from non-nuclear accidents involving nuclear weapons. 221 refs., 50 figs., 45 tabs. (DTT)

7858 (NUREG/CR—4355-Vol.1) ^{238}Pu(IV) in monkeys. Overview of metabolism. Durbin, P.W.; Jeung, N.; Schmidt, C.T. (Lawrence Berkeley Lab., CA (USA)). Sep 1985. Contract AC03-76SF00098. 95p. (LBL—20022-Vol.1). NTIS, PC A05/MF A01 - GPO. File Number TI86001210.

NONE

7859 (PNL—5633) Hanford Dose Overview Program. Comparison of AIRDOS-EPA and Hanford site dose codes. Aaberg, R.L.; Napier, B.A. (Pacific Northwest Labs., Richland, WA (USA)). Nov 1985. Contract AC06-76RL01830. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003155.

Radiation dose commitments for persons in the Hanford environs calculated using AIRDOS-EPA were compared with those calculated using a suite of Hanford codes: FOOD, PABLM, DACRIN, and KRONIC. Dose commitments to the population and to the maximally exposed individual (MI) based on annual releases of eight radionuclides from the N-Reactor, were calculated by these codes. Dose commitments from each pathway to the total body, lung, thyroid, and lower large intestine (LLI) are given for the population and MI, respectively. 11 refs., 25 tabs.

5602 THERMAL EFFECTS

7860 (N—85-11533) Man's physical tolerance to heat. Heat storage, burn injury. Danielsson, U. (Research Inst. of National Defence, Stockholm (Sweden)). May 1984. vp. (In Swedish). (FOA-C—54055-H1). NTIS, PC A04/MF A01.

English Summary.

Heat exposure time which results in 50% risk of heat exhaustion was calculated for metabolic heat production 150 W/sq m and 300 W/sq m, and air temperature and heat radiation between 60 C, 1200 W/sq m and 300 C, 7300 W/sq m. These parameters correspond to moderate and heavy physical workloads in an ordinary indoor fire. The effects of time to heat exhaustion were calculated for clothes with various insulations for air temperature 140 C. The shortest time to heat exhaustion, not resulting in heat injury, is 5 min if the body is uniformly exposed. The capacity of protective clothing to reduce heat load depends on the thickness of the material. (ESA)

5603 CHEMICALS METABOLISM AND TOXICOLOGY

REFER ALSO TO CITATION(S) 6891, 6909, 6920, 7805, 7834

7861 (DOE/EV/04580—6) Mechanisms and functional morphology associated with metal transport in Mercenaria mercenaria (Bivalvia:Mollusca). Progress report No. 6, 1 March 1984-1 September 1985. Robinson, W.E.; Morse, M.P. (New England Aquarium Corp., Boston, MA (USA). Harold E. Edgerton Research Lab.; Northeastern Univ., Boston, MA (USA). Marine Science Lab.). 30 Sep 1985. Contract AC02-77EV04580. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004089.

A brief overview is presented of work by these investigators on the bioaccumulation of silver or cadmium in various molluscs. 10 refs. (DT)

7862 **(DOE/EV/10321—T1) Carbon dioxide effect on mammalian tissue. An annotated bibliography with special subject analyses.** Thomas, S.C.; Shilling, C.W. (Undersea Medical Society, Inc., Bethesda, MD (USA)). 1980. Contract FG05-80EV10321. 107p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86003382.

This bibliography comprises citations dealing with the effects of low level and long term exposure to carbon dioxide on mammalian tissue. References to the causes of unconsciousness while under water are included. (ACR)

7863 **(LA-UR—85-3568) DNA analysis of epithelial cell suspensions.** Wilson, J.S.; Johnson, N.F.; Holland, L.M. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 22p. (CONF-8510225—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002403.

From Hanford life sciences symposium; Richland, WA, USA (21 Oct 1985).

Cell suspensions of skin were obtained by animals exposed by skin painting of several crude oils. DNA analysis of these cell suspensions labeled with mithramycin provide determination of percentages of cells in the G_1, S and G_2M phases of the cell cycle. Data acquired showed differences from control animals occurring as early as 7 days after treatment and persisting through 21 days afterwards. There was histological evidence of erythema and hyperplasia in shale oil-exposed skins. Flow cytometric analysis of DNA content in shale-oil-exposed skin cells showed an increased percentage of cycling cells plus evidence of aneuploidy. Similar data from simply abraded skin showed increased percentages of cycling cells, but no aneuploidy. The shale-oil-exposed group, when compared to a standard petroleum-exposed group, had significantly increased percentages of cycling cells. This early indication of differing response to different complex mixtures was also seen in long-term skin exposures to these compounds. Similar analytical techniques were applied to tracheal cell suspensions from ozone-exposed rats. 12 refs., 4 figs., 4 tabs. (DT)

7864 (LBL—18393, pp 38-40) **Effect of nickel chloride injections on prolactin receptor binding.** deManincor, D.J.; Clemons, G.K. Apr 1985. NTIS, PC A12/MF A01. File Number DE85010638.

In Biology and Medicine Division annual report, 1983-1984.

The well-documented role of prolactin as a mammotropic hormone has often overshadowed its other functions; however the finding that receptor binding is frequently correlated with specific physiologic functions has provided a convenient model whereby the function of prolactin can be investigated in other systems. Toxic substances that induce changes in prolactin levels would provide one avenue for such investigations. The authors have been working with nickel compounds that are considered to be an industrial health hazard. It has been demonstrated that subcutaneous injections of nickel chloride in the male rat cause significant increases in serum prolactin one to two days after administration, which were mediated via the neuroendocrine system. The authors are using this nickel chloride-induced increase of prolactin as a potential model for examining the role of prolactin in tissues other than the mammary gland.

7865 **(UCRL—15725) Carbon economy of higher plants under influences of atmospheric CO_2 and nitrogen nutrition.** Lafitte, R.; Loomis, R.S. (California Univ., Davis (USA). Dept. of Agronomy and Range Science). 31 Oct 1984. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002614.

Corn samples collected at the Lawrence Livermore National Laboratory from the CO_2 enrichment study have been analyzed for elemental composition, and the amount of glucose required to produce a unit of biomass has been calculated for the different treatments at two harvest dates. From these data, synthetic gas fluxes and theoretical yields can be predicted. 10 refs., 6 tabs.

7866 **(UCRL—92369) Applications of human sperm parameters for monitoring.** Wyrobek, A.J. (Lawrence Livermore National Lab., CA (USA)). Nov 1985. Contract W-7405-ENG-48. 21p. (CONF-8506220—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003488.

From Satellite symposium monitoring of occupational exposure to genotoxicants; Helsinki, Finland (30 Jun 1985).

Very few studies of male reproductive hazards in the workplace are being done, and there are several underlying problems slowing the process in this infant field. First, the interaction of many diverse disciplines from management, labor, government, medicine, and science is often required. Outlooks and incentives are generally in conflict from the outset. Second, there is considerable complacency because no workplace agent as toxic as DBCP has been found. Third, there is as yet no requirement to assess the human male reproductive effects of a compound before large groups of men are permitted to work with it. Fourth, there is a poor opinion of the available epidemiological methods as indicators of abnormal reproductive outcome, because they are expensive, prone to confounding factors, and small numbers of exposed men (and pregnancies at risk) limit their sensitivity. Fifth, sperm tests have been criticized for their variability, subjectivity, and lack of standardization. 68 refs., 2 tabs.

7867 **Alveolar permeability to protein in rats differentially susceptible to ozone.** Costa, D.L.; Schafrank, S.N.; Wehner, R.W.; Jellett, E. (Brookhaven National Lab., Upton, NY). *JAT, Journal of Applied Toxicology;* No. 3, 182-186(Jun 1985).

Sprague-Dawley rats susceptible (DS) to NaCl-induced hypertension suffer higher mortality when exposed daily to 2.0 ppm ozone than do hypertension-resistant (DR) rats, independent of salt in the diet or systemic blood pressure. To investigate one possible contribution to this differential sensitivity to ozone, alveolar permeabilities to serum albumin were measured both in ozone-exposed and in control DS and DR rats. Female rats aged 5-7 weeks maintained on a low-salt (0.4% NaCl) diet were injected intravenously with ^{125}I-bovine serum albumin and were then exposed to either 2.0 ppm ozone or air for 5 h. After pentobarbital anesthesia, the rats were exsanguinated and their lungs were lavaged in situ with saline. Lavage fluids and blood samples were measured for radioactivity using a NaI-well gamma counter. The results indicated that while DS and DR control rats have similar pulmonary permeabilities to ^{125}I-albumin, the lungs of the ozone-exposed DS animals were 63% (p less than 0.02) more permeable than those of DR rats exposed to ozone. Sloughing of epithelial tissue, mucous formation and an accumulation of macrophages in the end-airways were more pronounced among ozone-exposed DS animals than in DR-ozone-exposed rats. This increased damage among DS rats correlated well with the increased protein permeability levels. In similar studies, Sprague-Dawley (D) rats were more variable in their response to ozone than either inbred strain. However, the results appeared generally more like those of the DS animals, suggesting that the trait selected by inbreeding may have been resistance rather than sensitivity to ozone-induced lung injury.

7868 **Carcinogenic Potency Database of the standardized results of animal bioassays.** Gold, L.S.; Sawyer, C.B.; Magaw, R.; Backman, G.M.; de Veciana, M.; Levinson, R.; Hopper, N.K.; Havender, W.R.; Berstein, L.; Peto, R.; Pike, M.C. (Lawrence Berkeley Lab., CA). *Environmental Health Perspectives;* **58**: 9-319(Dec 1984).

This paper presents the Carcinogenic Potency Database, which includes results of about 3000 long-term, chronic experiments of 770 test compounds. Part II is a discussion of the sources of our data, the rationale for the inclusion of particular experiments and particular target sites, and the conventions adopted in summarizing the literature. Part III is a guide to the plot of results presented in Part IV. A number of appendices are provided to facilitate use of the database. The plot includes information about chronic cancer tests in mammals, such as dose and other aspects of experimental protocol, histopathology and tumor incidence, TD_{50} and its statistical significance, dose response, author's opinion and literature reference. The plot readily permits comparisons of carcinogenic potency and many other aspects of cancer tests; it also provides quan-

titative information about negative tests. The range of carcinogenic potency is over 10 million-fold. 467 references.

7869 **TD_{50}: a proposed general convention for the numerical description of the carcinogenic potency of chemicals in chronic-exposure animal experiments.** Peto, R.; Pike, M.C.; Bernstein, L.; Gold, L.S.; Ames, B.N. (Radcliffe Infirmary, Oxford, England). *Epsom Natural History Society, Proceedings;* **58**: 1-8(Dec 1984).

A generally accepted format for the numerical description of the carcinogenic potency of a particular chemical in a particular strain of animals is desirable so that statements from different sources about potency and attempts by different authors to correlate potency with particular laboratory measurements will be comparable. In this paper the authors recommend that TD_{50} (tumorigenic dose rate 50) be used. TD_{50} can be calculated for a single target site or combination of sites. The TD_{50}, in analogy with the LD_{50}, is defined as that chronic dose rate (in mg/kg body weight/day) which would have the actuarially adjusted percentage of tumor-free animals at the end of the standard experiment time. This paper consists of a brief discussion of the TD_{50}, sufficient to make the general reader familiar with the properties of such an index, an appendix discussing methods for its estimation and certain conventions the authors have adopted for use in analyzing nonstandard experiments. A major problem in calculating any index of carcinogenic potency is that much published material gives only the final crude percentage of tumor-bearing animals at each dose, instead of percentages adjusted for the effects of intercurrent mortality or data from which these adjusted percentages can be derived. If the dose level administered to the animals is toxic, then premature death from non-neoplastic causes may prevent some dosed animals that would have developed tumors from actually doing so. This will particularly affect the high-dose group. Consequently, any estimate of carcinogenic potency that is based on crude percentages of tumor-bearing animals, not adjusted for intercurrent mortality, may underestimate the carcinogenicity of the test material.

7870 **Poor survival of offspring from female rats previously exposed to perinatal propylthiouracil.** Van Middlesworth, L. (Univ. of Tennessee, Memphis). *Hormone and Metabolic Research;* **16**: No. 8, 385-456(Aug 1984).

Pregnant rats were fed 0.02% propythiouracil (PTU) in their drinking water during the last 4 days of pregnancy and the first 16 days of lactation. The survival of pups from rats previously exposed to perinatal propylthiouracil was tabulated. Results indicate that 73% of the pups from peri-PTU dams were dead two days after birth. Perinatal hypothyroidism in rats has been associated with persistent abnormalities, even though the animals may appear normal. These experiments do not clarify whether perinatal hypothyroidism or a non-thyroid effect of PTU caused the peri-PTU rats to have subnormal survival of pups.

5604 OTHER ENVIRONMENTAL POLLUTANT EFFECTS

REFER ALSO TO CITATION(S) 7779

7871 **(LBL—20053) Biological effects and physical safety aspects of NMR imaging and in vivo spectroscopy.** Tenforde, T.S.; Budinger, T.F. (Lawrence Berkeley Lab., CA (USA)). Aug 1985. Contract AC03-76SF00098. 60p. (CONF-8508145—1). NTIS, PC A04/MF A01; GPO Dep. File Number DE86002966.

From American Association of Physicists in medicine summer school; Portland, OR, USA (4 Aug 1985).

An assessment is made of the biological effects and physical hazards of static and time-varying fields associated with the NMR devices that are being used for clinical imaging and in vivo spectroscopy. A summary is given of the current state of knowledge concerning the mechanisms of interaction and the bioeffects of these fields. Additional topics that are discussed include: (1) physical effects on pacemakers and metallic implants such as aneurysm clips, (2) human health studies related to the effects of exposure to nonionizing electromagnetic radiation, and (3) extant guidelines for limiting exposure of patients and medical personnel to the fields produced by NMR devices. On the basis of information available at the present time, it is concluded that the fields associated with the current generation of NMR devices do not pose a significant health risk in themselves. However, rigorous guidelines must be followed to avoid the physical interaction of these fields with metallic implants and medical electronic devices. 476 refs., 5 figs., 2 tabs.

7872 **(ORNL—6094) Scientific rationale for the selection of toxicity testing methods. II. Teratology, immunotoxicology, and inhalation toxicology.** Ryon, M.G.; Sawhney, D.S. (eds.). (Oak Ridge National Lab., TN (USA)). Sep 1985. Contract AC05-84OR21400. 253p. (EPA—560/6-84-004). NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86003507.

This document is the second of a two-part literature analysis of parameters associated with the various toxicity testing methods (test anial selection, pathology, etc.). Acute, subchronic, chronic, and carcinogenic testing methods are covered in ORNL/EIS-151. Testing methods for developmental toxicity, immunotoxicology, and inhalation toxicology and research needs associated with these areas are covered in this volume, ORNL-6094. These reports were prepared for the purpose of assisting and supporting the US Environmental Protection Agency in its efforts to develop guidelines for more efficient and economical testing procedures. 416 refs., 29 figs., 27 tabs.

57 HEALTH AND SAFETY

7873 **(LA—10426-MS) Wellness Center use at Los Alamos National Laboratory: a descriptive study.** Wiggs, L.D.; Wilkinson, G.S.; Weber, C. (Los Alamos National Lab., NM (USA)). Oct 1985. Contract W-7405-ENG-36. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86004365.

This study describes employee participation during the first six months of the Los Alamos National Laboratory's corporate Wellness Program. We describe temporal patterns of use, preferred activities, frequency of use, and characteristics of employees participating in Wellness activities. Characteristics of Wellness participants are compared with characteristics of the Laboratory population. During this period the Wellness Center, a multi-use facility that houses Wellness Program activities, had 17,352 visits. Employees visiting the Wellness Center were typical of the Laboratory population in their racial and ethnic characteristics, but different in their sex and age composition. Wellness participants were younger and more likely to be female than the Laboratory population. 6 refs., 19 tabs.

58 GEOSCIENCES

5801 GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 7011, 7022, 7792

7874 **(CEA-CONF—7484) Underground fluid flow in a geothermal system in the natural state. Approach of the Eniwetok atoll case.** Samaden, G.; Dallot, P.; Roche, R. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Oct 1984. 31p. (In French). (CONF-8410349—2). NTIS (US Sales Only), PC A03/MF A01. File Number DE86750305.

From International colloquium on SAID-SPWLA logs; Paris, France (23 Oct 1984).

The following study uses temperature logging to show up the preference ways of underground waters and the bulk permanent movement inside the atoll. A general underground flow model has been established together with the corresponding computer program. The results obtained with a 3 layer model and a 5 layer model are presented.

7875 **(USGS-PP—712-F) Sources and mechanisms of recharge for ground water in the west-central Amargosa Desert, Nevada: a geochemical interpretation. Hydrology of nuclear test sites.** Claassen, H.C. (Geological Survey, Reston, VA (USA)). 1985. Contract AI08-76DP00474. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003843.

Ground water in the west-central Amargosa Desert, Neveda, was recharged primarily by overland flow of snowmelt in or near the present-day stream channels, rather than by subsurface flow from highland recharge areas to the north. Geochemical arguments, including reaction mechanisms, are used to support these findings. Carbon-, hydrogen-, and oxygen-isotope data show that much of the recharge in the area occurred during late Wisconsin time. Absence of ground water recharged prior to late Pleistocene is considered to indicate that either climatic conditions were unfavorable for recharge or that ground-water velocities were such that they transported this earlier recharge away from the study area.

7876 **Fluid flow along very smooth joints at effective pressures up to 200 megapascals.** Engelder, T.; Scholz, C.H. (Columbia Univ., Palisades, NY). pp 147-152 of Mechanical behavior of crustal rocks. Washington, DC; American Geophysical Union (1981). Contract AC02-76ER04054.

Flow rates and thus permeability were measured within very smooth joints in Cheshire quartzite. Measurement of the change in aperture with effective pressure shows that at effective pressures of less than 20 MPa, changes in confining pressure have a larger influence on the permeability than changes in pore pressure. Although a cubic law model for flow within a joint gives a rough estimate of joint permeability, the use of joint aperture as the only variable in the cubic law model for flow is inadequate for calculating joint permeability. It is suggested that the effective cross section available for flow changes with effective pressure in a nonlinear manner and a modified cubic law to account for this behavior is presented.

5802 GEOPHYSICS

REFER ALSO TO CITATION(S) 7032

7877 **(CNRS-CPT—84-1596) Cycle-octave and related transforms in seismic signal analysis.** Goupillaud, P.; Grossmann, A.; Morlet, J. (Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique). Mar 1984. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86750300.

High-resolution seismic methods are needed especially in oil and gas field development. They involve the use of backscattered energy rather than that reflected signals and make it interesting to look for representations of seismic traces in the time-frequency domain. One such representation was introduced by D. Gabor in 1946 into signal analysis: it is based on the consideration of a family of "elementary wavelets" that can be obtained form one "basic wavelet" by shifts in time and in frequency. We present here a different representation, in which frequency shifts are replaced by dilations. The resulting "voice transform" and "cycle-octave transform" are briefly described from the mathematical point of view illustrated by numerical examples.

7878 **(IFP—32-898) Attenuation of multiple reflexions in the (p-tau) plane.** Agoudjil, A. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison; Paris-6 Univ., 75 (France)). Dec 1984. 150p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE86750291.

To remove or at least, attenuate the multiple reflections (which hinders the geological interpretation) two techniques are generally used: multiple coverage and predictive deconvolution. A new type of seismic data handling is present-day these last years: the (p,tau) plane is used where tau is a time (intercept) and p is the apparent horizontal velocity inverse. The slant stack allows to use (p-tau) plane from (x-t) plane. The aim of this study is double - to analyze the seismic impulsion modifications related to slant stack, and in particular for reflections in infinite and continuous case and finite and discrete case; - to characterize the multiple presence in the (p-tau) plane in evaluating their spectra with regard to the primary reflection one together with the filter related to their presence for each slope. At last are presented the multiple attenuation programs based on a) techniques justified by seismic organization in (p-tau) plane b) on analysis techniques of the correlation between a primary reflection and its multiple, c) on filtering techniques related to the stacking direction.

7879 **(NVO—294) Pacific Enewetak Atoll cratering exploration completion report.** (Holmes and Narver, Inc., Las Vegas, NV (USA). Energy Support Div.). Sep 1985. Contract AC08-76NV00020. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86002149.

The primary objectives of this seaborne drilling operation were to obtain sufficient quantities of continuous, high quality carbonate core/samples, an integrated suite of geophysical logs, and other sub-sea floor data from within and adjacent to the KOA and OAK craters. This information is vital to refinement of previous interpretation and model studies detailing the dynamics of crater formation and to confirm residual postshot changes of the underlying formations. Specifically, the information obtained will provide an accurate understanding of the original dimensions of the transient craters and through precise analysis of material property samples will lead to an understanding of the response behavior of the lagoon sediments beneath the craters. All program objectives were accomplished. A total of 32 precisely positioned exploratory holes were completed in KOA and OAK craters from a drill ship in water depths of 30 to 200 ft. (Reference Appendix I for summary drilling curves of each borehole.)

7880 **(UCRL—15730) Seismic exposure analysis.** (Woodward-Clyde Consultants, Walnut Creek, CA (USA)). 25 Sep 1985. Contract W-7405-ENG-48. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86003487.

This report summarizes the results of a seismic exposure (probabilistic seismic hazard) assessment for the LLNL site. The purpose was to develop a seismic exposure analysis and to test the sensitivity of the results to various assumptions and uncertainties in input parameters. Some of the elements of the analysis were incorporation of uncertainties in source characterization parameters (source geometry, maximum magnitudes, slip rates, etc.) through the use of logic trees, which allow for weighting of alternative input parameters; development of fault-specific recurrence relationships from geologic slip rates, and comparison of these relationships with regional seismicity data; consideration of various published ground motion attenuation relationships to test sensitivity; and examination of the relative contribution to exposure from each seismic source and various magnitude increments. 31 figs.

7881 **(USGS-OFR—85-530) Free-air gradient observations in Yucca Flat, Nye County, Nevada.** Powers, P.S.; Healey, D.L. (Geological Survey, Denver, CO (USA)). 1985. Contract AI08-76DP00474. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003621.

In Yucca Flat, Nevada Test Site, the free-air gradient (F) has been calculated from international formulas and from surface gravity data. It has also been determined from measurements on, or near, the ground surface and at an elevated position vertically above. The latter (measured), has been the principal method of determining F at Yucca Flat. The free-air gradient is used to reduce borehole gravity meter (BHGM) data to the interval bulk density. Any error in F translates directly to an error in the interval bulk density. Therefore, the value for F must be determined as accurately as possible. Errors in F affect the interval gravity value (Δg) and can occur from operator reading error, vibrations, and incorrect terrain corrections. Measurement inaccuracies when determining the interval height (Δh) can also influence F. Each of these factors and the magnitude of these possible errors are discussed. 76 measured free-air gradient values in Yucca Flat are studied in this report. The measured F values range from a low of 0.089 to a high of 0.096 mGal/ft. These values range from -5.38% to +2.02% of the theoretical value of 0.09406 mGal/ft (0.3086 mGal/m). The mean value is 0.092015 mGal/ft, and the estimated standard deviation is 0.001266 mGal/ft. A contour map of the Yucca Flat F values was produced after the random spaced were converted to a regular spaced grid by use of the computer program MINC. 22 refs., 6 figs., 3 tabs.

5803 MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 7011, 7024, 7036, 7037, 7038

7882 **(BMI/ONWI—582) Investigation of the suspected presence of solid hydrocarbon in bedded salt samples from the Palo Duro Basin, Texas.** (Stone and Webster Engineering Corp., Boston, MA (USA)). Oct 1985. Contract AC02-83CH10140. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003439.

This report contains laboratory test results for two bedded salt samples from the Grabbe No. 1 (PD-2) Well of the Palo Duro Basin, Texas. This study was commissioned to determine whether or not solid hydrocarbons exist in bedded salt samples in the Palo Duro Basin. Laboratory investigations include electron microprobe examinations on polished thin sections and optical examinations and chemical tests on insoluble residues of the salt samples. No direct evidence was found that identifiable solid hydrocarbons are present in either sample of the bedded salt core. The total carbon content of the two salt samples was measured yielding 0.016 and 0.022 weight percent carbon. Detailed microscopic analyses showed that the carbon in the samples was associated with calcite, clays, and the epoxy resin used in sample preparation.

7883 **(DOE/ER/04054—T2) Fluid flow through marble; the relationship between permeability and pore fluid chemical saturation. Annual report. Appendix A.** Scholz, C.H. (Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory). [1985]. Contract AC02-76ER04054. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003831.

Fluid flow experiments have been conducted on split cylindrical samples of Vermont marble using distilled water as the pore fluid. The permeability and pore fluid chemical composition were monitored over time. The equilibrium saturation of Calcite and high Mg calcite in distilled water, initial P/sub CO_2/ = 10/sup -3.5/ and pH = 5.6, at 60 MPa is calculated and compared with the experimental results. Permeability and chemical composition data indicate that a distinction can be made between the first run after surface polishing and successive runs without additional surface preparation. Samples run immediately following surface polishing reach steady state permeability values at the same time they reach steady state chemical concentrations, about 48 hours after initial loading. The steady state chemical concentrations are super-saturated for the system at 25 C and 60 MPa. Experiments run without surface preparation show steady state chemical concentrations which are lower and initial concentrations which are the same or higher than those for experiments run just after surface preparation. Permeability changes for experiments without surface preparation are a factor of 10 or more lower than for experiments just after surface preparation. The permeability and chemical response of the system also show a dependence on whether the sample has experienced initial loading from 0 to 60 MPa. 11 refs., 7 figs.

7884 **(SAND—85-0213) Pretest reference calculation for the overtest for simulated defense high level waste (WIPP) Room B in situ experiment).** Morgan, H.S.; Stone, C.M. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1985. Contract AC04-76DP00789. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86004173.

A pretest reference calculation for the Overtest for Simulated Defense High-Level Waste (DHLW) or Room B experiment is presented in this report. The overtest is one of several large-scale, in-situ experiments currently under construction near Carlsbad, New Mexico at the site of the Waste Isolation Pilot Plant (WIPP). Room B, a single isolated room in the underground salt formation, is to be subjected to a thermal load of approximately four times the areal heat output anticipated for a future repository with DHLW. The load will be supplied 3 years by canister heaters placed in the floor. Room B is heavily instrumented for monitoring both temperature increases due to the thermal loading and deformations due to creep of the salt. Data from the experiment are not available at the present time, but the measurements will eventually be compared to the results presented to assess and improve thermal and mechanical modeling capabilities for the WIPP. The thermal/structural model used here represents the state of the art at the present time. A large number of plots are included since an appropriate result is presented for every Room B gauge location. 81 figs., 4 tabs.

7885 **(LA-tr—85-50) Fluid phases in the system K_2O-MgO-SiO_2-H_2O and their possible significance for the genesis of ultrabasic rocks.** Seifert, F.; Schreyer, W. Translated from *Berichte der Bunsengesellschaft fuer Physikalische Chemie ;* 70: No. 9/10, 1045-1050(1966). Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002859.

Experimental investigations at a pressure of 1000 atm and temperatures of 500 to 900°C yielded extensive fields of molten silicate liquids in the system K_2O-MgO-SiO_2-H_2O. Since the compositions of these melts approximate the limiting system MgO-SiO_2-H_2O that is important for ultrabasic rocks, even relatively small potassium contents can convert ultrabasics into so-called "crystal mushes" (coexistence of crystals and molten liquid), which remain capable of migration and thus of intrusion down to ca. 700°C. At lower temperatures, a K-rich gas replaces the liquid, and can escape from the now completely solidified ultrabasic to cause alkalization in the neighboring rock. 20 refs., 5 figs.

5804 GEOCHEMISTRY

REFER ALSO TO CITATION(S) 7043

5805 OCEANOGRAPHY

REFER ALSO TO CITATION(S) 7023

7886 **(BNL—37114) Discussion of the Ionian and Levantine Seas, NATO workshop on atmospheric and oceanic circulation in the Mediterranean Basin.** Hopkins, T.S. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 30p. (CONF-8405226—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE86002931.

From Symposium on containment fluxes through the coastal zone; Nantes, France (14 May 1984).

The gross features and distinctiveness of its thermohaline circulation are described for the Ionian and Levantine Seas of the eastern Mediterranean. The paper also discusses the significance of the thermohaline coupling with neighboring Mediterranean basins. 22 refs. (ACR)

64 PHYSICS I

6401 ASTROPHYSICS AND COSMOLOGY

REFER ALSO TO CITATION(S) 8033

7887 **(ANL-HEP-CP—85-100) Evidence from the Soudan 1 experiment for underground muons associated with Cygnus X-3.** Ayres, D.S. (Argonne National Lab., IL (USA)). Sep 1985. Contract W-31-109-ENG-38. 10p. (CONF-850883—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003062.

From 19. international cosmic ray conference; La Jolla, CA, USA (11 Aug 1985).

The Soudan 1 experiment has yielded evidence for an average underground muon flux of $\sim 7 \times 10^{-11}$ cm^{-2} s^{-1} which points back to the x-ray binary Cygnus X-3, and which exhibits the 4.8 h periodicity observed for other radiation from this source. Underground muon events which seem to be associated with Cygnus X-3 also show evidence for longer time variability of the flux. Such underground muons cannot be explained by conventional models of the propagation and interaction of cosmic rays. 16 refs., 5 figs., 1 tab.

7888 **(CONF-850869—9) Underground muons from Cygnus X-3.** Price, L.E. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004055.

From Meeting of the Particles and Fields Division of the American Physical Society; Eugene, OR, USA (12 Aug 1985).

Underground detectors, intended for searches for nucleon decay and other rare processes, have recently begun searching for evidence of astrophysical sources, particularly Cygnus X-3, in the cosmic ray muons they record. Some evidence for signals from Cygnus X-3 has been reported. The underground observations are reported here in the context of previous (surface) observations of the source at high energies. 25 refs., 8 figs.

7889 **(DOE/ER/05007—22) Particle theory and cosmology. Progress report, April 1, 1985-March 31, 1986.** Gaisser, T.K.; Steigman, G. (Delaware Univ., Newark (USA). Bartol Research Foundation). 15 Nov 1985. Contract AC02-78ER05007. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003169.

A review of work in progress is given for models, using properties of particle interactions to extrapolate to energy realms which exceed accelerator limits. In addition models are discussed for cosmology and astrophysics. 28 refs., (WRF)

7890 **(FNAL/C—85/134-A) Searching for cygnets.** Kolb, E.W. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1985. Contract AC02-76CH03000. 11p. (CONF-850785—5; CONF-8506195—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002994.

From 5. international conference on physics in collision; Autun, France (3 Jul 1985).

The reported observation in underground detectors of high-energy muons from the direction of the compact binary X-ray source CYG X-3 (2030 + 4047) cannot be explained by conventional physics. In this paper some explanations for the effect based upon unconventional physics are reviewed. 17 refs., 2 figs.

7891 **(LA-UR—85-3315) Formation of galactic halos in the cold dark matter universe: computer simulations.** Quinn, P.J.; Salmon, J.K.; Zurek, W.H. (California Inst. of Tech., Pasadena (USA); Los Alamos National Lab., NM (USA)). 12 Sep 1985. Contract W-7405-ENG-36. 2p. (CONF-8506199—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000822.

From International astronomical union meeting; Princeton, NJ, USA (24 Jun 1985).

The formation of structure on the galactic scale in the cold dark matter, $\Omega = 1$ universe is simulated.

7892 **(LBL—20344) Spectrum of the cosmic background radiation: early and recent measurements from the White Mountain Research Station.** Smoot, G.F. (Lawrence Berkeley Lab., CA (USA)). Sep 1985. Contract AC03-76SF00098. 12p. (CONF-8508148—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002888.

From Conference on research work at the U.C. Research Station at White Mountain; Bishop, CA, USA (30 Aug 1985).

The White Mountain Research Station has provided a support facility at a high, dry, radio-quiet site for measurements that have established the blackbody character of the cosmic microwave background radiation. This finding has confirmed the interpretation of the radiation as a relic of the primeval fireball and helped to establish the hot Big Bang theory as the standard cosmological model.

7893 **Goldstone bosons in string models of galaxy formation.** Davis, R.L. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* **32**: No. 12, 3172-3177(15 Dec 1985). Contract AC03-76SF00515.

One reason why cosmic strings are interesting is because they may provide the primordial density fluctuations that began the process of galaxy formation. For the scenario in which galaxies condense around oscillating closed loops it is necessary that gravitational radiation be the dominant energy-loss mechanism. It is shown that loops of strings from a broken exact global symmetry decay too quickly to serve this purpose. Loops of strings from a broken gauge symmetry may have Goldstone-boson couplings as well. It is shown that the decay rate of these strings due to Goldstone-boson emission is strongly suppressed. This supports the conjecture that gauge strings may seed galaxy formation.

7894 **"Isothermal" density perturbations in an axion-dominated inflationary universe.** Seckel, D.; Turner, M.S. (NASA/Fermilab Astrophysics Center, Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Physical Review* [*Section*] *D: Particles and Fields;* **32**: No. 12, 3178-3183(15 Dec 1985).

In inflationary models of the Universe which are axion dominated both adiabatic and isothermal density perturbations arise. We point out that the isothermal perturbations can be more important than the adiabatic perturbations and discuss a model for which this is the case. With isothermal perturbations the spectrum of density perturbations when structure formation begins is flatter and we briefly discuss the implications of this fact. That the amplitude of isothermal fluctuations not be too large provides yet another constraint on models of inflation.

7895 **Cosmological constraints on heavy unstable particles.** Choi, K.; Kang, K.; Kim, J.E. (Department of Physics, Seoul National University, Seoul 151, Korea). *Physical Review* [*Section*] *D: Particles and Fields;* **32**: No. 10, 2822-2827(15 Nov 1985). Contract AC02-76ER03130.

We present cosmological constraints for the heavy unstable particles. The main result is the lifetime versus mass plot of the heavy unstable particles M. These kinds of particles are predicted in many composite-fermion models. If the grand unification mass M/sub X/ is around 10^{15} GeV, dimension-6 M-decaying operators are necessary to allow heavy composite particles above 10/sup 7.6/ GeV.

7896 **High-energy themal synchrotron emission.** Imamura, J.N.; Epstein, R.I.; Petrosian, V. (Los Alamos National Laboratory). *Astrophysical Journal;* **296**: No. 1, 65-68(1 Sep 1985).

We compute thermal synchrotron spectra for which the photon energy is comparable to the mean electron thermal energy. In this regime it is necessary to include the restriction that a photon receives no more energy than the kinetic energy of the radiating electron. The derived spectra fall off more rapidly at high energies than was previously estimated. We find that the thermal synchrotron mechanism can still provide satisfactory fits to the very hard γ-ray burst spectra for sufficiently high temperatures and low magnetic fields. For instance, the 1982 January 25 burst, observed by the SMM satellite, which showed significant emission out to 20 MeV, can be fitted by thermal synchrotron spectra provided that the temperature exceeds about 2 MeV (2.4×10^{10} K) and the Larmor energy is less than about 8.2 keV (7×10^{11} G).

7897 **Stability properties of white dwarf radiative shocks.** Imamura, J.N. (Los Alamos National Laboratory). *Astrophysical Journal;* **296**: No. 1, 128-141(1 Sep 1985).

We study the oscillatory instability of white dwarf radiative accretion shocks discovered by Langer, Chanmugam, and Shaviv. We extend previous works by studying the properties of (1) shocks with power-law cooling functions proportional to rhoT/sup α/ rather than to rho^{2}T/sup α/; (2)= shocks dominated by bremsstrahlung and Compton cooling; and (3) shocks dominated by bremsstrahlung and Compton cooling when the effects of electron thermal conduction are not negligible. The results of our calculations allow us to delineate the stability regimes of white dwarf radiative shocks as a function of the dwarf mass, M/sub asterisk/, and the accretion rate, M. We parameterize M in terms of the optical depth to electron scattering through the preshock flow, tau/sub es/. In the Compton cooling and bremsstrahlung case, the shocks are unstable to low-order oscillation modes if M/sub asterisk/ $<$ or $\approx$(0.7 +- 0.1) M/sub sun/ for tau/sub es/ = 14, and if M/sub asterisk/ $<$ or $\approx$(0.9 +- 0.1)= M/sub X/ for tau/sub es/ = 1. When electron thermal conduction is added, low-order oscillation modes are unstable only if M/sub asterisk/ $<$ or $\approx$(0.3 +- 0.1) M/

sub sun/. The unstable modes have approximate oscillation periods of 1.1tau/sub br/ and 0.63tau/sub br/, where tau/sub br/ is the bremsstrahlung cooling time scale of the postshock plasma. If an oscillatory instability is observed, constraints can be placed on the mass of the accreting white dwarf.

7898 **Theoretical calculation of rapid x-ray transients and radius expansion.** Starrfield, S.; Sparks, W.; Truran, J.; Kenyon, S. (Department of Physics, Arizona State University, Tempe, AZ 85287). *AIP (American Institute of Physics) Conference Proceedings;* **115**: No. 1, 298-301(26 May 1984).

We present the results of a calculation of a thermonuclear runaway on a 10 km neutron star which produced a precursor, radius expansion, and after the envelope had begun to shrink, a seconds x-ray burst about 2500 second later. Although such an event has not yet been observed, decreasing the initial envelope mass should bring the calculations into better agreement with the observations.

7899 **Nuclear physics problems for accreting neutron stars.** Wallace, R.K.; Woosley, S.E. (University of California Los Alamos National Laboratory Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **115**: No. 1, 319-324(26 May 1984).

The importance of $p(e^- \nu)n$ and of (p,γ) reactions on ^{56}Ni during a thermonuclear runaway on a neturon star surface is pointed out. A fast 16-isotope approximate nuclear reaction network is developed that is suitable for use in hydrodynamic calculations of such events.

7900 **Theory of gamma-ray bursts.** Woosley, S.E. (Board of Studies in Astronomy and Astrophysics University of California, Santa Cruz CA 95064). *AIP (American Institute of Physics) Conference Proceedings;* **115**: No. 1, 485-511(26 May 1984).

A γ-ray burst occurs when a strongly magnetic neutron star experiences either a thermonuclear explosion in degenerate material accumulated over a long period of time or the sudden, brief, greatly super-Eddington accretion of matter. Certain aspects of the thermonuclear model are briefly reviewed and the necessity that low-luminosity pulsars (e.g. X-Per) occasionally undergo nuclear runaways stressed (although X-Per is obviously not the prototypical burster). Greatest attention is devoted to mechanisms for producing the hard spectrum of γ-ray bursts. A leading candidate utilizes the high (parallel) temperature developed behind an accretion shock. Hard radiation is produced by inverse Compton as cyclotron photons emitted beneath the shock diffuse out. The shock itself may be a consequence of either nuclear explosion at a conjugate point or accretion and may be collisionless in nature. A new model for the production of optical flashes accompanying γ-ray bursts is developed which relies upon the cyclotron emission of electrons at $\sim 10^9$ cm (in a wind or accretion flux) pumped by Compton collisions with γ-rays from the burst. Strong optical flashes should only come from strongly magnetic neutron stars, the optical emission should be coincident with the γ-emission, and the optical radiation may be polarized.

7901 **Gamma burst emission from neutron star accretion.** Colgate, S.A.; Petschek, A.G.; Sarracino, R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **115**: No. 1, 548-554(26 May 1984).

A model for emission of the hard photons of gamma bursts is presented. The model assumes accretion at nearly the Eddington limited rate onto a neutron star without a magnetic field. Initially soft photons are heated as they are compressed between the accreting matter and the star. A large electric field due to relatively small charge separation is required to drag electrons into the star with the nuclei against the flux of photons leaking out through the accreting matter. The photon number is not increased substantially by bremsstrahlung or any other process. Instability in an accretion disc might provide the infalling matter required.

7902 **Theory of optical flashes.** London, R.A. (University of California, Lawrence Livermore National Laboratory Livermore, California 94550). *AIP (American Institute of Physics) Conference Proceedings;* **115**: No. 1, 581-589(26 May 1984). Contract W-7405-ENG-48.

The theory of optical flashes created by X- and γ-ray burst heating of stars in binaries is reviewed. Calculations of spectra due to steady-state X-ray reprocessing and estimates of the fundamental time scales for the non-steady case are discussed. The results are applied to the extant optical data from X-ray and γ-ray bursters. Finally, I review predictions of flashes from γ-ray bursters detectable by a state of the art all-sky optical monitor.

7903 **3-10 keV and 0.1 to 2 MeV observations of four gamma-ray bursts.** Laros, J.G.; Evans, W.D.; Fenimore, E.E.; Klebesadel, R.W.; Shulman, S.; Fritz, G. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **115**: No. 1, 378-389(26 May 1984).

Four catalogued γ-ray bursts that occurred between 79/3/7 and 79/7/31 have been observed over the 3-10 keV range by a joint NRL/Los Alamos experiment on the Air Force P78-1 satellite. The bursts were also well observed by members of the interplanetary network. In this paper we present hardness ratios, X-ray/γ-ray luminosity ratios, and time histories. The most significant results presented herein can be summarized as follows: (1) Gamma-ray bursters can emit fairly strongly at X-ray energies near the time of the γ burst with L/sub x//L/sub γ/$\sim$.02 (L/sub x/$\sim 10^{39}$ ergs s^{-1}, 3-10 keV, assuming a distance of 1 kpc). (2) The centroid of the X-ray emission generally lags the γ-ray centroid, but there is also evidence for one or more types of X-ray precursor activity. (3) The γ-ray hardness ratios were not highly variable for these particular events. However, there is some evidence that the γ-ray spectra softened near the ends of the bursts when the X-ray/γ-ray ratios were high. (4) The X-ray/γ-ray power law number index during times of the strongest γ-ray emission ranged from 0.8 to $\sim$1.1 for the four bursts. (5) The X-ray tail of GB790307 probably can be modeled as the cooling of hot plasma generated during the γ-ray burst. Simple versions of this model can be used to estimate various source parameters. These estimates imply a distance of a few hundred to a few thousand pc. (6) Gamma-ray bursters probably do not produce events similar to "classical" X-ray bursts independently of the γ-ray emission.

7904 **Log n-log s is inconclusive (Expurgated version of title).** Klebesadel, R.W.; Fenimore, E.E.; Laros, J.G. (University of California, Los Alamos National Laboratory Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **115**: No. 1, 429-433(26 May 1984).

The log N-log S data acquired by the Pioneer Venus Orbiter Gamma Burst Detector (PVO) are presented and compared to similar data from the Soviet KONUS experiment. Although the PVO data are consistent with and suggestive of a -3/2 power law distribution, the results are not adequate at this state of observations to differentiate between a -3/2 and a -1 power law slope.

7905 **Inverse comptonization vs. thermal synchrotron.** Fenimore, E.E.; Klebesadel, R.W.; Laros, J.G. (University of California, Los Alamos National Laboratory Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **115**: No. 1, 590-596(26 May 1984).

There are currently two radiation mechanisms being considered for gamma-ray bursts: thermal synchrotron and inverse comptonization. They are mutually exclusive because thermal synchrotron requires a magnetic field of $\sim 10^{12}$ Gauss, whereas inverse comptonization cannot produce a monotonic spectrum if the field is larger than 10^{11} and is too inefficient relative to thermal synchrotron unless the field is less than 10^9 Gauss. Neither mechanism can explain completely the observed characteristics of gamma-ray bursts. However, we conclude that thermal synchrotron is more consistent with the observations if the sources are $\sim$40 kpc away, whereas inverse comptonization is more consistent if they are $\sim$300 pc away. Unfortunately, the source distance still is not known and, thus, the radiation mechanism still is uncertain.

7906 **Physics of the synchrotron model of cosmic gamma ray bursts.** Liang, E.P. (Lawrence Livermore National Laboratory Livermore, California 94550). *AIP (American Institute of Physics) Conference Proceedings;* **115**: No. 1, 597-604(26 May 1984). Contract W-7405-ENG-48.

We review the theoretical arguments leading to the thermal synchrotron model of cosmic gamma ray bursts. We propose a magnetic flare-resonant absorption mechanism for the production of the hot electrons that can account for most of the unusual properties of the emission layer.

6402 ATMOSPHERIC PHYSICS

7907 **(AD-A—157123/1/XAB) Calculation of threshold conditions for materials charging in Maxwellian plasmas. Interim report.** Rubin, A.G.; Tautz, M. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 25 Jan 1985. 18p. (AFGL-TR—85-0020). NTIS, PC A02/MF A01.

Space plasmas at geosynchronous orbit are usually not characterized by a single Maxwellian distribution function. Plasmas are characterized as single Maxwellians to first order and as a sum of two Maxwellians as a better approximation. A threshold electron-temperature condition for charging of materials in the single Maxwellian is derived. Conditions for materials charging in the dual-Maxwellian case are derived and illustrated. These are threefold: an initial negative current; a threshold electron temperature; and a threshold electron current.

7908 **(LA-UR—85-3676) Experimental aspects of ion acceleration and transport in the Earth's magnetosphere.** Young, D.T. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 57p. (CONF-8506196—2). NTIS, PC A04/MF A01; GPO Dep. File Number DE86002409.

From Chapman conference ion acceleration; Wellesley, MA, USA (3 Jun 1985).

Major particle population within the Earth's magnetosphere have been studied via ion acceleration processes. Experimental advances over the past ten to fifteen years have demonstrated the complexity of the processes. A review is given here for areas where composition experiments have expanded perception on magnetospheric phenomena. 64 refs., 6 figs., 1 tab. (WRF)

7909 **Specularly reflected ions, shock foot thicknesses, and shock velocity determination in space.** Gosling, J.T.; Thomsen, M.F. (University of California, Los Alamos Laboratory, New Mexico). *Journal of Geophysical Research;* **90**: No. A10, 9893-9896(1 Oct 1985).

The magnetic foot of a quasi-perpendicular, supercritical collisionless shock is spatially coincident with an caused by gyrating ions nearly specularly reflected from the shock. The reflected ions are turned around by the upstream magnetic field and returned to the shock after completing a partial gyration. An expression is derived for the turnaround distance of specularly reflected ions for arbitrary orientations of the incident velocity vector and the upstream magnetic field. This expression is then used to derive a formula for calculating the shock speed in the spacecraft frame from a single point measurement of the time required for the magnetic foot to transit a spacecraft. The derived formulas for turnaround distance and shock speed differ from previously published equations for these parameters and in some geometries give quantitatively very different results.

6403 ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

REFER ALSO TO CITATION(S) 7574, 7598, 7657, 7994

7910 **(CONF-8411153—5) Ultra-sensitive isotopic analysis by resonance ionization mass spectrometry.** Donohue, D.L.; Christie, W.H.; Goeringer, D.E.; McKown, H.S. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003252.

From International conference on lasers '84; San Francisco, CA, USA (26 Nov 1984).

A high-powered pulsed dye laser has been interfaced to a commerical ion microprobe mass analyzer. This combination should provide ultra-high sensitivity for isotope ratio measurements of selected elements in environmental samples. The technique is an outgrowth of resonance ionization mass spectrometry which has demonstrated high precision for isotope ratio determinations of uranium and plutonium using thermal filament atomization. Sputter atomization using a pulsed argon ion beam represents a significant improvement in efficiency because the temporal overlap between the atom cloud and the laser pulse can approach 100%. This, coupled with the high ionization efficiency of laser induced resonance ionization methods, promises an analytical sensitivity which is significantly better than other microprobe techniques. A description of the experimental set-up is given along with the modifications to the ion microprobe instrument which were necessary to obtain acceptable ion extraction efficiency. Also shown are results for samarium and uranium demonstrating the optical and mass spectra obtained. 21 refs., 7 figs., 1 tab.

7911 **(DOE/ER/10376—T6) Studies of autoionizing states relevant to dielectronic recombination. Final report.** Gallagher, T.F. (SRI International, Menlo Park, CA (USA)). 11 Oct 1985. Contract AT03-79ER10376. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86002908.

Dielectronic recombinaation, the inverse of autoionization, is a process leading to significant power loss in CTR plasmas. Although it is known that dielectronic recombination proceeds via autoionization Rydberg states, few data exist on autoionizing states and how they are affected by conditions found in a CTR plasma. Under this research program we have been using a novel laser excitation technique developed at SRI to study autoionizing states and the perturbing effects of electric fields found in CTR plasmas. We describe experimental investigations of the spectroscopy of autoionizing Rydberg states, the energy analysis of electrons ejected from autoionizing states, autoionizing in electric fields, and the autoionization induced by an electric field. 33 refs., 16 figs.

7912 **(IS-T—1194) Molecular beam photoionization spectrometry. I. Photoionization studies of high temperature vapors. II. State-selected and state-to-state studies of electron transfer reactions.** Liao, C.L. (Ames Lab., IA (USA)). Oct 1985. Contract W-7405-ENG-82. 192p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86002117.

This thesis consists of six sections which can be grouped into two main parts. Each section represents an independent article in a format ready for submission for publication with minor modifications. The figures, tables and references cited in each section refer only to those contained in that section.

7913 (IS-T—1194, pp 7-23) **Molecular beam photoionization study of S_2.** Oct 1985. NTIS, PC A09/MF A01. File Number DE86002117.

In Molecular beam photoionization spectrometry. I. Photoionization studies of high temperature vapors. II. State-selected and state-to-state studies of electron transfer reactions.

Higher resolution photoionization efficiency data for the formation of S_2^+ and S^+ from S_2 in the wavelength region of 600 to 1350 A have been obtained using the supersonic oven beam method. The ionization energy (IE) of S_2 is determined to be 9.356 +- 0.002 eV. The measured appearance energy of 14.732 +- 0.005 eV for the dissociative ionization process $S_2 + h\nu \rightarrow S^+ + S + e^-$, together with the IE of S_2, yields a value of 5.376 +- 0.005 eV for the bond dissociation energy of S_2^+. Two Rydberg series converging to the b/sup ~4/Σ/sub g/⁻ state (13.20 eV) of S_2^+ are observed.

7914 (IS-T—1194, pp 24-38) **Molecular beam photoionization study of Hg_2.** Oct 1985. NTIS, PC A09/MF A01. File Number DE86002117.

In Molecular beam photoionization spectrometry. I. Photoionization studies of high temperature vapors. II. State-selected and state-to-state studies of electron transfer reactions.

Photoionization efficiency data for Hg_3^+ have been obtained in the region of 650 to 1400 A. The ionization energy of Hg_3 was determined to be 9.103 +- 0.010 eV. This value allows the calculation of the dissociation energy of Hg_3^+ to be 1.40 +- 0.02 eV. By analyzing the differences in energy between corresponding autoionization peaks observed in the Hg^+ and the Hg_3^+ spectra and by assuming the charge induced-dipole interaction to be the dominant interaction between $Hg^+(^2D/sub\ 5/2,3/2/)$ and Hg at the equilibrium bond distance of Hg_3, the equilibrium bond distance for Hg_3 was deduced to be 3.35 A.

7915 (IS-T—1194, pp 39-52) **Molecular beam photoionization study of HgKr and HgXe.** Oct 1985. NTIS, PC A09/MF A01. File Number DE86002117.

In Molecular beam photoionization spectrometry. I. Photoionization studies of high temperature vapors. II. State-selected and state-to-state studies of electron transfer reactions.

Photoionization efficiency data for $HgKr^+$ and $HgXe^+$ have been obtained in the region of 730 to 1290 A. The ionization energies (IE) of HgKr and HgXe were determined to be 10.056 +- 0.012 eV (1233 +- 1.5 A) and 9.709 +- 0.011 eV (1277 +- 1.5 A), respectively. Using these values, the known dissociation energies of HgKr and HgXe and the IE of Hg, the binding energies for the ground state mercury-rare gas molecular ions were deduced to be 0.393 +- 0.013 eV for $HgKr^+$ and 0.748 +- 0.013 eV for $HgXe^+$. By analyzing the shifts in energy between corresponding autoionization peaks observed in the Kr^+, $HgKr^+$, Xe^+, and $HgXe^+$ spectra and by assuming the charge induced-dipole interaction to be the dominant interaction at the equilibrium bond distances for HgKr and HgXe, the equilibrium bond distances for HgKr and HgXe were deduced to be 3.98 and 4.23 A, respectively. The latter values are in excellent agreement with values determined by previous spectroscopic studies.

7916 (IS-T—1194, pp 54-127) **Study of the symmetric charge transfer reaction $H_3^+ + H_2$ using the high resolution photoionization and crossed ion-neutral beam methods.** Oct 1985. NTIS, PC A09/MF A01. File Number DE86002117.

In Molecular beam photoionization spectrometry. I. Photoionization studies of high temperature vapors. II. State-selected and state-to-state studies of electron transfer reactions.

A new ion-molecular reaction apparatus, which combines the crossed ion-neutral beam method, high resolution photoionization mass spectrometry, and charge transfer detection, has been developed. Using this apparatus, we have examined the relative total charge transfer cross sections of $H_3^+ + H_2$ as a function of the vibrational state of H_3^+, $v_0' = 0$ to 4, at the center-of-mass collision energy (E/sub c.m./) range of 0.38 to 200 eV. The relative total transfer cross sections measured at E/sub c.m./ = 8, 16, 22.5, and 200 eV are in general agreement with a recent theoretical calculation based on the semiclassical energy conserving trajectory formulation. The vibrational energy effects on the charge transfer and the $H_3^+ + H$ channels at low collision energies (E/sub c.m./ $\leq$ 1 eV) were directly observed. The rotational states, J = 0, 1, and 2, of $H_3^+(v_0' = 0)$ were also selected in this experiment. Within experimental uncertainties, the rotational excitations of $H_3^+(v_0' = 0)$ show no effect on the relative total charge transfer cross sections at E/sub c.m./ = 2 and 4 eV.

7917 (IS-T—1194, pp 128-140) **Vibrational state distributions of $H_3^+(v'')$ resulting from the electron transfer reactions $H_2^+(v_0' = 0.1) + H_2(v_0'' = 0) \rightarrow H_2(v') + H_3^+(v'')$ in the collisional energy range of E/sub c.m./ = 2 to 16 eV.** Oct 1985. NTIS, PC A09/MF A01. File Number DE86002117.

In Molecular beam photoionization spectrometry. I. Photoionization studies of electron transfer reactions of high temperature vapors. II. State-selected and state-to-state studies of electron transfer reactions.

The vibrational state distributions of product $H_3^+(v'')$ resulting from the symmetric charge transfer reactions $H_3^+(v_0' = 0$ or 1) + $H_2(v_0'' = 0) \rightarrow H_2(v') + H_3^+(v'')$ in the center-of-mass collisional energy (E/sub c.m./) range of 2 to 16 eV have been measured by the charge exchange method. When reactant H_3^+ ions are prepared in $v_0' = 0$, the majority (>80%) of product H_3^+ ions are formed in $v'' = 0$. The vibrational relaxation channel for forming $H_3^+(v'' = 0)$ is found to be much more efficient than the vibrational excitation process for producing $H_3^+(v'' = 1)$ in the $H_3^+(v_0' = 1) + H_2(v_0'' = 0)$ charge transfer collisions. The experiment also reveals that inelastic charge transfer channels become more important as E/sub c.m./ is increased. The vibrational state distributions of product $H_3^+(v'')$ determined at E/sub c.m./ = 8 and 16 eV are compared with results of the semiclassical energy conserving trajectory calculations of Lee and DePristo. A better agreement between experimental and theoretical results is observed at E/sub c.m./ = 16 eV, a collisional energy at which charge transfer is the overwhelming channel.

7918 (IS-T—1194, pp 141-186) **State-to-state study of the symmetric charge transfer reaction $Ar^+(^2P/sub\ 3/2,1/2/) + Ar(^1S_0)$.** Oct 1985. NTIS, PC A09/MF A01. File Number DE86002117.

In Molecular beam photoionization spectrometry. I. Photoionization studies of high temperature vapors. II. State-selected and state-to-state studies of electron transfer reactions.

The relative state-to-state total charge transfer cross sections σ 3/2 $\rightarrow$ 3/2, etc., σ 3/2 $\rightarrow$ 1/2, σ 1/2 $\rightarrow$ 1/2, and σ 1/2 $\rightarrow$ 3/2, for the reactions $Ar^+(2P3/2) + Ar(1S0) \rightarrow Ar(1S0) + Ar^+(2P3/2)$, $\rightarrow Ar(1S0) + Ar^+(2P1/2)$, $Ar^+(2P1/2) + Ar(1S0) \rightarrow Ar(1S0) + Ar^+(2P1/2)$, and $\rightarrow Ar(1S0) + Ar^+(2P3/2)$, respectively, at the laboratory collision energy range of 1 to 4000 eV, have been determined using the newly constructed crossed ion-neutral beam photoionization apparatus. This apparatus is equipped with a high resolution photoionization ion source for reactant state selections and a charge transfer detector for product state identifications.

7919 (LA-UR—85-3245) **Superposition principle for CIDS by heirarchical molecular structures.** Patterson, C.W.; Bustamante, C. (Los Alamos National Lab., NM (USA); New Mexico Univ., Albuquerque (USA). Dept. of Chemistry). 1985. Contract W-7405-ENG-36. 7p. (CONF-8506217—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86000767.

From CRDC conference; Aberdeen, MD, USA (17 Jun 1985).

We show that circular intensity differential scattering (CIDS) of light by macromolecules with different levels of chiral structure is the superposition of the CIDs from each individual level. As an example, we treat a model superhelix eith anisotropic polarizability. 8 refs., 4 figs.

7920 (LA-UR—85-3571) **Neutron vibrational spectroscopy: the use of hydrogen as a structural and dynamical probe.** Eckert, J. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 18p. (CONF-850871—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002401.

From International conference on neutron scattering; Santa Fe, NM, USA (19 Aug 1985).

The large incoherent scattering cross-section of hydrogen combined with an exact knowledge of the form of the scattering function can be utilized in neutron spectroscopic experiments to study local structural environments as well as interaction strengths. An inportant application of this technique is to focus on a particular hydrogen atom, or hydrogenous molecular group in the material, mainly by employing isotopic substitution. Hydrogen is thereby used as a local probe of structure as well as dynamics. Examples include: site geometry and occupancy in metal hydrides, potential well geometry of hydrogen-metal complexes and hydrogen-bonded systems, and dynamical coupling in linear chain hydrogen-bonded materials. 19 refs., 3 figs.

7921 (LA-UR—85-3846) **Theoretical studies of the C_4 molecule.** Ritchie, J.P.; King, H.F.; Young, W.S. (Los Alamos National Lab., NM (USA); State Univ. of New York, Buffalo (USA)). 1985. Contract W-7405-ENG-36. 13p. (CONF-8508119—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002429.

From NATO advanced study institute: advances in chemical reaction dynamics; Iraklion, Crete (25 Aug 1985).

Optimized geometries and relative energies for three states of the C_4 molecule have been obtained from single-reference configuration interaction (SRCI) calculations. At the SRCI level, a

rhombic form is calculated to lie 1.1 kcal below the triplet form; consideration of the Davidson correction reduces this difference to 0.4 kcal, while more complete basis sets are expected to increase the difference only by about 0.2 kcal. Consideration of these effects and difference in zero-point energy leads to a final estimated splitting of 1.2 kcal, favoring the rhombus. To aid the determination of the ground state, preliminary estimates of the lowest optical transitions were obtained from SRCI calculations and vibrational frequencies were obtained from SCF calculations. Comparison of the calculated results with experimentally obtained spectra suggest the possibility that both the linear triplet and the rhombus may have already been observed. 19 refs., 4 figs., 4 tabs.

7922 **(LBL—20295) Picosecond dynamics of reactions in the liquid phase: studies of iodine photodissociation and development of new laser techniques.** Berg, M.A. (Lawrence Berkeley Lab., CA (USA)). Sep 1985. Contract AC03-76SF00098. 187p. NTIS, PC A09/MF A01; GPO Dep. File Number DE86002895.

Thesis.

Iodine photodissociation and recombination was studied as a model for processes common to chemical reaction in the liquid phase. Picosecond transient absorption measurements from 1000 to 295 nm were used to monitor the dynamics in a variety of solvents. Most of the atoms which undergo geminate recombination were found to do so in $\leq$ 15 ps, in agreement with the results of existing molecular dynamics simulations. Vibrational relaxation times vary from $\sim$15 ps near the middle of the ground state well to $\sim$150 ps for complete relaxation to v = 0. The prediction of strong resonant vibrational energy transfer to chlorinated methane solvents was not supported, but some evidence for this mechanism was found for alkane solvents. Current theory is unable to explain the large variation (65 to 2700 ps) of the excited A'-state lifetime in various solvents. The 10-Hz amplified, synchronously-pumped dye laser which was used in these studies is described and characterized. SERS (Stimulated Electronic Raman Scattering) and difference frequency mixing were used in the generation of the infrared and far-infrared, respectively. 54 refs., 38 figs., 3 tabs. (WRF)

7923 **(UCRL—90712) Electronic structure of neutral and singly ionized curium.** Worden, E.F.; Conway, J.G.; Blaise, J. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA); Centre National de la Recherche Scientifique, 91 - Orsay (France). Lab. Aime Cotton). Feb 1985. Contract W-7405-ENG-48. 13p. (CONF-841210—30). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002625.

From International chemical congress of Pacific Basin Society; Honolulu, HI, USA (16 Dec 1984).

Extensive observations and analyses of the emission spectra of neutral and singly ionized curium, Cm I and Cm II, have resulted in the determination of 785 Cm I and 598 Cm II energy levels. These levels then combine to classify 9145 of the more than 14,250 lines of ^{244}Cm observed between 240 and 2650 nm. Most of the levels have Lande g-values from Zeeman effect data and isotope shifts trom measurements of spectra from sources with various enrichments of ^{244}Cm, ^{245}Cm, ^{246}Cm, and ^{248}Cm. These data allowed many levels to be assigned to specific electronic configurations. The ground configurations of Cm I and Cm II are [Rn] $5f^7 6d7s^2$ and [Rn] $5f^7 7s^2$, respectively. The realtive energies of other electronic configurations of Cm are given and compared with analogous configurations in other actinides and in Gd its lanthanide analogue. 2 refs., 5 figs., 7 tabs.

7924 **(UCRL—93608) Collective vector method for calculation of E1 moments in atomic transition arrays.** Bloom, S.D.; Goldberg, A. (Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 35p. (CONF-8510172—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE86003471.

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

The CV (collective vector) method for calculating E1 moments for a transition array is described and applied in two cases, herein denoted Z26A and Z26B, pertaining to two different configurations of iron VI. The basic idea of the method is to create a CV from each of the parent ("initial state") state-vectors of the transition array by application of the E1 operator. The moments of each of these CV's, referred to the parent energy, are then the rigorous moments for that parent, requiring no state decomposition of the manifold of daughter state-vectors. Since, in cases of practical interest, the daughter manifold can be orders of magnitude larger in size than the parent manifold, this makes possible the calculation of many moments higher than the second in situations hitherto unattainable via standard methods. The combination of the moments of all the parents, with proper statistical weighting, then yields the transition array moments from which the transition strength distribution can be derived by various procedures. We describe two of these procedures: (1) The well-known GC (Gram-Charlier) expansion in terms of Hermite polynomials, (2) The Lanczos algorithm or Stieltjes imaging method, also called herein the delta expansion. Application is made in the cases of Z26A (50 lines) and Z26B (5523 lines) and the relative merits and shortcomings of the two procedures are discussed. 10 refs., 15 figs., 2 tabs.

7925 **Effect of pressure on electronic excitations in TCNQ and its complexes.** Tkacz, M.; Jurgensen, C.W.; Drickamer, H.G. (School of Chemical Sciences, Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). *Journal of Chemical Physics;* **84**: No. 2, 649-653(15 Jan 1986). Contract AC02-76ER01198.

The electronic spectra of TCNQ and TCNQ complexes has been investigated at high pressure up to 150 kbar. The observed pressure shifts are discussed in terms of intermolecular interactions. The results are also compared with available theoretical calculations.

7926 **Visible and infrared spectroscopy of matrix-isolated PuF_6.** Dewey, H.J.; Barefield J.E. II; Rice, W.W. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **84**: No. 2, 684-691(15 Jan 1986).

Absorption, emission, and excitation spectra have been obtained for the infrared and visible transitions of matrix-isolated PuF_6 in argon. Analysis of the data yields ground-state vibrational frequencies for the six fundamentals, precise electronic state energies, and excited-state vibrational frequencies.

7927 **He_2 potential at small distances.** Ceperley, D.M.; Partridge, H. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Chemical Physics;* **84**: No. 2, 820-821(15 Jan 1986). Contract W-7405-ENG-48.

Quantum Monte Carlo methods have been used to determine the exact Born—Oppenheimer interaction energy of two helium atoms with internuclear separations between 0.5 and 1.8 A. There is reasonable agreement with potentials derived from scattering data, however the semiempirical Aziz potential is too repulsive for separation less than 1.8 A. We propose a new potential for this region.

7928 **Diode laser probe of CO_2 vibrational excitation produced by collisions with hot deuterium atoms from the 193 nm excimer laser photolysis D_2S.** O'Neill, J.A.; Cai, J.Y.; Flynn, G.W.; Weston R.E. Jr. (Department of Chemistry and Columbia Radiation Laboratory, Columbia University, New York, New York 10027). *Journal of Chemical Physics;* **84**: No. 1, 50-58(1 Jan 1986). Contract AC02-78ER04940.

The 193 nm excimer laser photolysis of D_2S in D_2S/CO_2 mixtures produces fast deuterium atoms (E/sub TR/$\sim$2.2 eV) which vibrationally excite CO_2 molecules via inelastic translation—vibration/rotation (T—V/R) energy exchange processes. A high resolution (10^{-3} cm^{-1}) cw diode laser probe was used to monitor the excitation of ν_3 (antisymmetric stretch) and ν_2 (bend) vibrations in CO_2. The present results are compared with previous experiments involving hot hydrogen atom excitation of CO_2 in H_2S/CO_2 mixtures as well as with theoretical calculations of the excitation probability. The probability for excitation of a ν_3 quantum in CO_2 is about 1%—2% per gas kinetic D/CO_2 collision. Bending (ν_2) quanta are produced about eight times more efficiently than antisymmetric stretching (ν_3) quanta. The thermalization rate for cooling hot D atoms below the threshold for production of a ν_3 vibra-

tional quantum corresponds to less than 2 D^*/D_2S collisions or 15 D^*/CO_2 collisions.

7929 Vibrational state distributions of $H^+Z(v'')$ resulting from the electron transfer reactions $H^+_2(v'_0 = 0, 1) + H_2(v''_0 = 0) \rightarrow H_2(v') + H^+_2(v'')$ in the collisional energy range of 2—16 eV. Liao, C.L.; Ng, C.Y. (Ames Laboratory, U. S. Department of Energy, and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics;* **84**: No. 1, 197-200(1 Jan 1986). Contract W-7405-ENG-82.

The vibrational state distributions of product $H^+_2(v'')$ resulting from the symmetric charge transfer reactions $H^+_2(v'_0 = 0$ or 1) $+H_2(v''_0 = 0) \rightarrow H_2(v') + H^+_2(v'')$ in the center-of-mass collisional energy (E/sub c.m./) range of 2—16 eV have been measured by the charge exchange method. When reactant H^+_2 ions are prepared in v/sup prime/$_0 = 0$, the majority (>80%) of product H^+_2 ions are formed in $v'' = 0$. The vibrational relaxation channel for forming $H^+_2(v'' = 0)$ is found to be much more efficient than the vibrational excitation process for producing $H^+_2(v'' = 2)$ in the H^+_2(v/sup /$_0 = 1) + H_2$(v/sup double-prime/$_0 = 0$) charge transfer collisions. The experiment also reveals that inelastic charge transfer channels become more important as E/sub c.m./ is increased. The vibrational state distributions of product $H^+_2(v'')$ determined at E/sub c.m./ = 8 and 16 eV are compared with results of the semiclassical energy conserving trajectory calculations of Lee and DePristo. A better agreement between experimental and theoretical results is observed at E/sub c.m./ = 16 eV, a collisional energy at which charge transfer is the overwhelming channel.

7930 Analytic Raman intensities from molecular electronic wave functions. Frisch, M.J.; Yamaguchi, Y.; Gaw, J.F.; Schaefer H.F. III; Binkley, J.S. (Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **84**: No. 1, 531-532(1 Jan 1986).

An analytic method for the evaluation of Ramanintensities from closed-shell self-consistent-field wave functions is presented. Predictioinsf or ethylenemolecule are also reported. (AIP)

7931 Photoelectron spectroscopy of HO^-Z. Oakes, J.M.; Harding, L.B.; Ellison, G.B. (Department of Chemistry, University of Colorado, Boulder, Colorado 80309). *Journal of Chemical Physics;* **83**: No. 11, 5400-5406(1 Dec 1985).

The photoelectron spectroscopy of HO^-_2 and DO^-_2 has been studied. We find the electron affinities (E.A.) of the corresponding radicals to be E.A.$(HO_2) = 1.078 +- 0.017$ eV and E.A.$(DO_2) = 1.089 +- 0.017$ eV; the gas phase acidity of hydrogen peroxide is ΔH/sup circle-open//sub acid/ $(HO_2—H) = 376.4 +- 0.6$ kcal/mol. The electron spectra show only one active mode which we assign as the HO—O stretch (ω_3). By modeling the Franck—Condon factors we deduce a molecular structure for the HO^-_2 ion: r_0(HO—O) = 1.50 A, r_0(H—OO) = 0.97 A, and angle(H—O—O) = 104°. A parallel set of GVB/PP, GVB-CI, and POL-CI ab initio electronic structure computations has been carried out for this ion.

7932 Study of electron wave functions in uranium tetrachloride by neutron scattering. Lander, G.H.; Brown, P.J.; Spirlet, M.R.; Rebizant, J.; Kanellakopulos, B.; Klenze, R. (Institute Laue Langevin, 156X, 38042 Grenoble, France and Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **83**: No. 11, 5988-5997(1 Dec 1985).

Neutron experiments have been performed to measure the induced spin density distribution in single crystals of uranium tetrachloride at low temperature. A structural refinement has also established the atomic positions and thermal parameters at low temperature and these are in agreement with earlier studies. The spin-density distribution, determined with polarized neutrons, shows small but significant deviations from that expected from the single-ion crystal-field model. Fourier difference maps show a small depletion of the (5f) density near the U site and a small positive increase ~1 A from the U site and principally along the shorter U—Cl bonds. We ascribe this to population of a 6d (x^2-y^2) orbital. No significant spin density is associated with the Cl site. Model calculations are presented which qualitatively account for the observed effect and involve electron transfer from the 5f to the 6d antibonding orbital formed as a result of a covalent interaction between the U 6d and Cl p states. This is the first direct observation of covalency in systems involving 5f 6d electrons.

7933 Low-energy total-electron-capture cross sections for fully stripped and H-like projectiles incident on H and H_2. Meyer, F.W.; Howald, A.M.; Havener, C.C.; Phaneuf, R.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] A: General Physics;* **32**: No. 6, 3310-3318(Dec 1985).

Total-electron-capture cross sections are reported for fully stripped and H-like ions of C, N, O, F, and Ne colliding with atomic and molecular hydrogen targets in the energy range 0.18—8.5 keV/amu. At energies above 3 keV/amu the cross sections are approximately energy independent with magnitudes in the range (4—7) x 10^{-15} cm^2, and scale smoothly with projectile charge. Below 3 keV/amu the H-target cross sections for projectiles with even charge are smaller than those for projectiles of odd charge. For the H_2-target data, the opposite trend prevails. For those systems where calculations exist, molecular orbital and atomic orbital close-coupling calculations are within 20% of the experimental results except at the lowest energies investigated.

7934 Monte Carlo calculation of electron scattering from surface films. Williamson W. Jr.; Antolak, A.J. (University of Toledo, Department of Physics and Astronomy, Toledo, Ohio 43606). *Journal of Applied Physics;* **58**: No. 10, 3687-3691(15 Nov 1985).

The electron backscattering coefficient and reflected energy for surface films on bulk substrates have been computed using the photon-electron Monte Carlo transport code sandyl. The calculations were done for the film/substrate configurations Al/Pt, Ag/Pt, Ag/Al, and Au/Al with incident electron beam energies of 20, 40, 60, and 100 keV at different angles of incidence and various film thicknesses. The backscattering results are compared with available experimental data taken at normal incidence.

7935 Charge Transfer of Hydrogen Ions and Atoms in Metal Vapors. Morgan, T.J.; Olson, R.E.; Schlachter, A.S.; Gallagher, J.W. (Wesleyan University, Middletown, Connecticut 06457). *Journal of Physical and Chemical Reference Data;* **14**: No. 4, 971-1040(Oct 1985).

Cross sections and equilibrium fractions for energetic H^+, H^-, and H^0 in collisions with metal-vapor targets have been compiled and evaluated. Both experimental and theoretical results are reported. Sources of errors are discussed, and recommended values for the data are presented.

7936 (LA-tr—85-16-Rev.) Ion sources for high-frequency accelerators. Keller, R. (Los Alamos National Lab., NM (USA); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). 1985. Contract W-7405-ENG-36. Translation of VDI-Bildungswerk 41-18-02, Berlin, May 3, 1982. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003563.

Ion sources are being applied increasingly in many areas of physics and technology, from basic research in nuclear and atomic physics to energy research, isotope separation, implanation technology, surface processing and analysis all the way to biomedicine. It is impossible within the framework of this discussion to provide a comprehensive survey of the variety of avialable source types. The function and problems of the types important for high-frequency accelerators are to be explained using a few individual examples in order to stimulate a basic understanding for this technically sophisticated and little-known equipment. The sources discussed here supply singly or multiply charged, positive ions. 54 refs., 18 figs.

6404 FLUID PHYSICS

REFER ALSO TO CITATION(S) 7428

7937 (LBL—20276) Convergence of a random walk method for the Burgers equation. Roberts, S. (Lawrence Berkeley Lab., CA (USA)). Oct 1985. Contract AC03-76SF00098. 100p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86004001.

In this paper we consider a random walk algorithm for the solution of Burgers' equation. The algorithm uses the method of fractional steps. The non-linear advection term of the equation is solved by advecting "fluid" particles in a velocity field induced by the particles. The diffusion term of the equation is approximated by adding an appropriate random perturbation to the positions of the particles. Though the algorithm is inefficient as a method for solving Burgers' equation, it does model a similar method, the random vortex method, which has been used extensively to solve the incompressible Navier-Stokes equations. The purpose of this paper is to demonstrate the strong convergence of our random walk method and so provide a model for the proof of convergence for more complex random walk algorithms; for instance, the random vortex method without boundaries.

7938 (UCRL—93503) ODRIC: a one-dimensional linear resistive MHD code in cylindrical geometry. Mirin, A.A.; Bonugli, R.J.; O'Neill, N.J.; Killeen, J. (Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003798.

The primitive resistive MHD equations in cylindrical geometry are time-advanced. Fourier analysis in the poloidal and toroidal directions and subsequent linerization are performed, resulting in a 1-D (radial) system for the perturbed quantities. Separate equations for the electron and ion temperature perturbations are solved. Hall terms and the thermal force vector are included in Ohm's law. Anisotropic thermal conductivity and viscosity are included in the model.

7939 (UCRL—93522) Application of Hardy's multiquadric interpolation to hydrodynamics. Kansa, E.J. (Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 8p. (CONF-860119—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001906.

From Society for Computer Simulation (SCS) multiconference; San Diego, CA, USA (23 Jan 1986).

Hardy's multiquadric interpolation (MQI) scheme is a global, continuously differentiable interpolation method for solving scattered data interpolation problems. It is capable of producing monotonic, extremely accurate interpolating functions, integrals, and derivatives. Derivative estimates for a variety of one and two-dimensional surfaces were obtained. MQI was then applied to the spherical blast wave problem of von Neumann. The numerical solution agreed extremely well with the exact solution. 17 refs., 3 figs., 2 tabs.

7940 Accelerated convergence of the steepest descent method for magnetohydrodynamic equilibria. Handy, C.R.; Hirshman, S.P. (Department of Mathematics, University of Chicago, Chicago, Illinois 60637). *Journal of Computational Physics;* 60: No. 2, 338-345(15 Sep 1985). Contract W-7405-ENG-26.

The applicability of the epsilon-c-algorithm to rcursion relations relevant to MHD is considered. (AIP)

6451 PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

REFER ALSO TO CITATION(S) 7889

7941 (BNL—36635) Antineutron physics at BNL and beyond. Lowenstein, D; Chu, C.; Hungerford, E.; Kishimoto, T.; Mayes, B.; Pinsky, L.; Tang, L.; Xue, Y.; Armstrong, T.; Elinon, C. (Brookhaven National Lab., Upton, NY (USA); Houston Univ., TX (USA); Pennsylvania State Univ., University Park (USA); Rice Univ., Houston, TX (USA); Bonn Univ. (Germany, F.R.); Zagreb Univ. (Yugoslavia)). 1985. Contract AC02-76CH00016. 10p. (CONF-850152—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85014219.

From 3. LEAR workshop; Tignes-Savoie, France (19 Jan 1985).

The history of antineutron counter experiments below 1 GeV/c is rather short. Several measurements of the charge exchange total and differential cross-sections have been reported. In addition there have been a few low statistics attempts to measure the (anti np transmission and annihilation cross-sections. In 1981 at BNL, AGS Experiment 767 was proposed to simultaneously measure both the annihilation and the transmission cross-sections for anti np). The data were taken during the winter and spring of 1984 and very preliminary results were reported at Durham in July 1984. The results presented here represent a significantly more complete data analysis but some sources of systematic error are still under investigation, and as such only relative cross-sections will be quoted which should still be regarded as preliminary to some degree.

7942 (BNL—37189) Photon physics at RHIC. Skuja, A.; White, D.H. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 18p. (CONF-8504152—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002925.

From Workshop on experiments for Relativistic Heavy Ion Collider (RHIC); Upton, NY, USA (15 Apr 1985).

Two photon processes induced by heavy ion collisions have been considered. An approximate formalism for calculation is derived. The event rate is interesting at low-photon-photon mass but is limited by the form factor of the nuclei at high mass. The event rate is compared with that at LEP and found to be favorable at the mass of charm mesons but unfavorable at higher masses. It is further noted that two pomeron processes are similar in configuration and are prolific at low pomeron-pomeron masses. 3 refs., 8 figs.

7943 (CERN-EP—82-140) Preliminary results on hadron production in 200 GeV μ-copper and μ-carbon interactions. Nassalski, J. (Institute of Nuclear Research, Warsaw (Poland)). 6 Sep 1982. 13p. (CONF-8206117—10). NTIS (US Sales Only), PC A02/MF A01. File Number DE86900284.

From 13. international symposium on multiparticle dynamics; Volendam, Netherlands (6 Jun 1982).

A comparison is made between z, p/sub t/^{2} and rapidity distributions of hadrons produced in the interactions of 200 GeV muons with copper and carbon nuclei in the region $25 < W^2 < 290$ GeV^2. These data are also compared to 280 GeV muon-hydrogen data in the same W^2 range. Within the errors there is no significant difference in the distributions of fast hadrons produced on copper and carbon nuclei except perhaps at the lowest W^2 values.

7944 (CERN/EP—82-144) Charge distributions in nu p and anti nu p interactions. Morrison, D.R.O. (European Organization for Nuclear Research, Geneva (Switzerland)). 8 Sep 1982. 10p. (CONF-8106183—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE86900285.

From 12. international conference of multiparticle dynamics; Notre Dame, IN, USA (22 Jun 1981).

Results are presented and discussed on three topics: determination of the charge on a quark, possibility of separating target and beam fragments at present accelerator energies, and where the fragments of the current quark or of the target diquark system go. The results presented were obtained using a wideband neutrino beam in

the BEBC bubble chamber filled with hydrogen. The data are based on 8000 neutrino-proton and 4000 antineutrino-proton charged current interactions. 6 refs., 12 figs. (LEW)

7945 **(CERN/EP—82-150) Protonium spectroscopy and identification of P-wave and S-wave initial states of p anti p annihilations at rest with the ASTERIX experiment at LEAR.** Gastaldi, U. (European Organization for Nuclear Research, Geneva (Switzerland)). 1 Oct 1982. 33p. (CONF-8205103—15). NTIS (US Sales Only), PC A03/MF A01. File Number DE86900286.

From Workshop on physics at LEAR with low energy cooled antiprotons; Erice, Italy (9 May 1982).

The ASTERIX experiment was designed with three main objectives: to study the general features of p anti p interactions at rest, to extend the work done so far in the spectroscopy of light mesons produced by p anti p annihilations at rest, and to search with high sensitivity for gluonium, baryonium structures, and N anti N states bound by strong interactions. The impact on the experimental program of the choice of a gaseous hydrogen target instead of a liquid one and of a large acceptance x-ray detector is discussed. Then the rate and signature of antiprotons stopping in the gas target is discussed, the x-ray detector is described, results from some initial tests and estimates of the performance of the apparatus expected for protonium spectroscopy are given, and initial states are identified. 21 refs., 21 figs. (LEW)

7946 **(CERN-EP—82-180) UA1 results from anti pp collisions at radical s = 540 GeV.** Geer, S. (European Organization for Nuclear Research, Geneva (Switzerland)). 12 Nov 1982. 26p. (CONF-8208103—4). NTIS (US Sales Only), PC A03/MF A01. File Number DE86900290.

From 4. European symposium on anti NN and anti QQ interactions; Santiago de Compostella, Spain (30 Aug 1982).

A summary is given of the first years results from the UA1 experiment at the CERN SPS anti pp collider. Pseudo rapidity, multiplicity, rapidity gap, transverse momentum, and transverse energy distributions are discussed together with some of the relationships between these things. The results from an elastic scattering measureent and a search for Centauro-like events are also presented. 22 refs., 30 figs.

7947 **(CERN-EP—82-185) Observation of high transverse energy jets at the CERN proton-antiproton collider.** Revol, J.P. (European Organization for Nuclear Research, Geneva (Switzerland)). 17 Nov 1982. 31p. (CONF-8208103—5). NTIS (US Sales Only), PC A03/MF A01. File Number DE86900291.

From 4. European symposium on anti NN and anti QQ interactions; Santiago de Compostella, Spain (30 Aug 1982).

In the UA1 data, clear evidence is seen for jets. At high E/ sub T/ the jet structure becomes unambiguous. Some of our events are very spectacular. The preliminary cross-section reported here is in qualitative agreement with QCD. The mass distribution of our two-jet system already reaches the LEP energy region. For a very systematic study of jets and a search for Z^0, W+- and top quark in their jet decay modes we need more statistics, which we should obtain very soon. Before the end of this year the collider is expected to deliver about one month of data with a peak luminosity of $\simeq 3 \times 10^{28} cm^{-2} s^{-1}$. We should then have on the order of 10,000 events containing a pair of jets of mass larger than 90 GeV and extending up to at least 200 GeV.

7948 **(CONF-850171—3) Charmed meson lifetimes from 20 GeV photoproduction.** Brau, J.E. (Tennessee Univ., Knoxville (USA)). 1985. Contract AS05-76ER03956. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003161.

From 5. Moriond workshop on heavy quarks, flavor mixing and CP violation; La Plagne, France (13 Jan 1985).

A sample of 134 events containing 159 visible multiprong charm decays has been obtained from the 20 GeV charm photoproduction experiment at the SLAC Hybrid Facility. Following a selection procedure which ensures high and uniform detection efficiency for selected events, 47 charged, 46 neutral and five topologically ambiguous decays remain. These decays yield preliminary lifetimes of π/sub D/sup +-// = (9.2 +- 1.5 +- 0.5) x 10^{-13} secs π/ sub D/° ≅ (6.1 +- 1.1 +- 0.4) x 10^{-13} secs and a ratio (phi/sub D/ sup +-//)/(tau/sub D°/) = 1.5/sub -0.3//sup +0.6/ +- 0.1. One fully reconstructed four-body D^0 decay has a proper flight time of 55 x 10^{-13} seconds. 5 refs., 4 figs.

7949 **(DOE/ER/40130—2) Search for neutrino oscillations and measurements of neutrino-nucleus cross sections. Technical progress report, 16 January 1985-15 October 1985.** Koetke, D.D. (Valparaiso Univ., IN (USA). Dept. of Physics). 15 Oct 1985. Contract AC02-84ER40130. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003153.

Progress is reported in these areas: work done at LANL on experiment E764, including beam line modification, new target installation, system testing, on-line software development, beam tuning, and data acquisition; neutrino Monte Carlo program development; flux calculations for the DC modified torroidal pion focussing device for the low energy decay-in-flight neutrino source; and prototype preparation for a large modular segmented detector. (LEW)

7950 **(DOE/ER/40146—1-1) Medium energy physics at Syracuse University. Technical progress report.** Souder, P.A. (Syracuse Univ., NY (USA). Dept. of Physics). 1985. Contract FG02-84ER40146. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003747.

Our primary focus has been preparation for an experiment at the MIT - Bates Linear Accelerator Center to measure the electroweak interferance in the scattering of polarized electrons from carbon nuclei. We have been involved in all phases of the experiment, including the construction and testing of a polarized electron injector and the development of a spectrometer system that can detect the scattered electrons with great statistical precision. This experiment should be in the data taking phase by next year. Secondly, we have also helped form a collaboration to extract the three form factors of the deuteron at Bates. Tasks underway for this experiment include the design of a deuteron transport channel and the construction of a high power liquid deuterium target. Thirdly, we have obtained data in an experiment in which we have successfully searched for the exotic ion $\mu^+ e^- e^-$. This work was performed at LAMPF in collaboration with Yale University and the College of William and Mary.

7951 **(JINR—E-1-84-442) Momentum and angular distributions of charged secondaries in 40 GeV/c πpA interactions with single particle high Psub(tr) trigger.** Adam, C.; Bannikov, A.V.; Bohm, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1984. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85703256.

Momentum and angular spectra as well as rapidity and effective masses distributions of charged secondaries in 38 GeV/c. π^-C and π^-Pb interactions triggered on a single particle emitted at πN c.m.s. angles 85 deg-120 deg with transverse momentum Psub(perpendicular) >= 1 GeV/c are obtained. It is shown that the average transverse momenta of secondary hadrons for inelastic interactions and hadrons associated to the high Psub(perpendicular) particle coincide for the Pb-target and are slightly different for the C target. Increase of the excess of positively charged particles having momentum above 0.7 GeV/c in high Psub(perpendicular) processes on the Pb target in comparison with the C target is observed. These facts suggest the multiple rescattering mechanism of the high Psub(perpendicular) particle production on nuclei. It is shown that a considerable part of triggering particles in π^-C interactions originates from rho deg → $\pi^+\pi^-$ decay. 5 references, 5 figures.

7952 **(LBL—20463) Properties of heavy quark jets produced by e^+e^- annihilation at 29 GeV.** Rowson, P.C. (Lawrence Berkeley Lab., CA (USA)). Oct 1985. Contract AC03-76SF00098. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86003989.

The Mark II detector in the e^+e^- storage ring PEP at the Stanford Liner Accelerator Center (SLAC) is used to measure selected properties of hadronic events corresponding to produced bottom or charm quarks. Heavy flavor enrichment is accomplished by tagging events with prompt electrons or muons. Differences be-

tween bottom, charm and average jets are observed for momentum, transverse momentum, rapidity and jet mass distributions. A detailed study of the charged multiplicity of b- and c-enriched events finds the mean multiplicity of bottom and charm events to be 16.2 +- 0.5 +- 1.0 and 13.2 +- 0.5 +- 0.9, respectively, where the first error is statistical and the second is systematic. The corresponding 'non-leading' multiplicities of charged particles accompanying the pair of heavy hadrons are 5.2 +- 0.5 +- 0.9 for bottom, and 8.0 +- 0.5 +- 0.9 for charm. We find from these non-leading multiplicities that bottom and charm hadrons fragment with mean energy fractions of <z>/sub b/ = 0.79/sub -0.05//sup +0.10/ and <z>/sub c/ = 0.60/sub -0.11//sup +0.09/. These results confirm the expected hard fragmentation of heavy quarks and agree with previous measurements based on leptonic inclusive spectra and D^* fragmentation. 48 refs., 29 figs.

7953 **(SLAC—287) SLAC three-body partial wave analysis system.** Aston, D.; Lasinski, T.A.; Sinervo, P.K. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1985. Contract AC03-76SF00515. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003794.

We present a heuristic description of the SLAC-LBL three-meson partial wave model, and describe how we have implemented it at SLAC. The discussion details the assumptions of the model and the analysis, and emphasizes the methods we have used to prepare and fit the data. 28 refs., 12 figs., 1 tab.

7954 **(SLAC-PUB—3815) Search for anomalous single photon production at PEP.** Wilson, R.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1985. Contract AC03-76SF00515. 8p. (CONF-850869—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002158.

From Meeting of the Particles and Fields Division of the American Physical Society; Eugene, OR, USA (12 Aug 1985).

This talk reports a search for the production by e^+e^- annihilation of a single photon accompanied by particles that interact only weakly in matter. The search was performed at PEP ($\sqrt{s}$ = 29 GeV) with a new detector, ASP. No unexpected signal was observed. The limit N/sub nu/ < 14 (90% CL) is placed on the number of light neutrino species, and the mass of scalar electrons predicted by the theories of supersymmetry is constrained to m/sub $\sim e/ > 51$ GeV/c^2 (90% CL) for m/sub $\sim\gamma/ = 0$ and degenerate $\sim e$ mass states. 7 refs., 4 figs.

7955 **Comparison of cross sections from deep-inelastic neutrino scattering on neon and deuterium.** Hanlon, J.; Burnstein, R.A.; Rubin, H.A.; Kalelkar, M.; Brucker, E.B.; Jacques, P.F.; Koller, E.L.; Plano, R.J.; Stamer, P.E.; Chang, C.Y. (Illinois Institute of Technology, Chicago, Illinois 60616). *Physical Review [Section] D: Particles and Fields;* **32**: No. 9, 2441-2444(1 Nov 1985).

We compare cross sections derived from deep-inelastic neutrino scattering on neon and deuterium targets. Systematic effects are minimized by imposing identical analysis criteria on two experiments in the same detector with similar incident neutrino spectra, and by using variables independent of the beam energy estimate. Our results favor a previously observed dependence of nucleon structure functions on the target nucleus (the European Muon Collaboration effect), but do not require the existence of this phenomenon.

7956 **New determination of the Michel parameter in tau decay.** Behrends, S.; Gentile, T.; Guida, J.M.; Guida, J.A.; Morrow, F.; Poling, R.; Rosenfeld, C.; Thorndike, E.H.; Tipton, P.; Besson, D. (University of Rochester, Rochester, New York 14627). *Physical Review [Section] D: Particles and Fields;* **32**: No. 9, 2468-2470(1 Nov 1985).

We have used the leptonic decays of the tau to determine the Lorentz structure of its decay vertex. We find the Michel parameter rho to be 0.71 +- 0.09 +- 0.03, which is consistent with V-A (rho = 0.75) and inconsistent with V+A. This measurement represents the first such analysis using muons in the final state.

7957 **Analysis of inclusive KK-barπ from 11-GeV/c K^-p interactions.** Aston, D.; Carnegie, R.K.; Dunwoodie, W.; Durkin, S.; Estabrooks, P.G.; Hemingway, R.J.; Homa, A.; Hutchinson, D.; Johnson, W.B.; Kunz, P.F. (Stanford Linear Accelerator Center, Stanford University, P.O. Box 4349, Stanford, California 94305 Carleton University, Ottawa, Ontario, K1S 5B6 Canada National Research Council, Ottawa, Ontario, K1A 0R6 Canada). *Physical Review [Section] D: Particles and Fields;* **32**: No. 9, 2255-2269(1 Nov 1985). Contract AC03-76SF00515.

Inclusive production of the K/sub S/$^0K^{+-}\pi^{-+}$ system has been studied in K^-p interactions at 11 GeV/c using the large-aperture solenoid spectrometer at SLAC. We have isolated a sample of 3837 K-bar $^0K^+\pi^-$ and 3019 $K^0K^-\pi^+$ events. A Dalitz-plot analysis shows that the major quasi-two-body channel in the KK-barπ system is (K(K+c.c.). The data have been subjected to a partial-wave analysis as a function of KK-barπ mass. In the lower-mass region (1.2—1.8 GeV) the KK-barπ system is dominated by the J/sup P/ = 1^+ (K(K+c.c) amplitudes. No evidence is found for $\delta(980)\pi$ production in any J/sup P/ state. No clear KK-barπ resonant behavior is demanded by the data.

7958 **Inclusive production of multistrange hyperons from 11-GeV/c K^-p interactions.** Aston, D.; Carnegie, R.K.; Dunwoodie, W.; Durkin, S.; Estabrooks, P.G.; Hemingway, R.J.; Honma, A.; Hutchinson, D.; Johnson, W.B.; Kunz, P.F. (Stanford Linear Accelerator Center, Stanford University, P.O. Box 4349, Stanford, California 94305 Carleton University, Ottawa, Ontario, Canada K1S 5B6 National Research Council, Ottawa, Ontario, Canada K1A 0R6 University). *Physical Review [Section] D: Particles and Fields;* **32**: No. 9, 2270-2287(1 Nov 1985). Contract AC03-76SF00515.

Large samples of inclusively produced Ξ^-, Ω^-, and $\Xi^0(1530)$ events are presented from a 1427 events/μb exposure of the large-aperture superconducting-solenoid spectrometer to an 11-GeV/c K^- beam. Production characteristics of these states are compared with other data and shown to be consistent with hyperon exchange. Polarization of Ξ^- shows an increase in magnitude with both Feynman x and transverse momentum. The Ξ^- decay parameters are measured to be α/sub $\Xi/ = -0.40 +- 0.03$ and Phi/sub $\Xi/ = (5 +- 10)^0$. Results of searches for higher-mass hyperons are presented. The $\Xi^-(1820)\to\Xi^0(1530)\pi^-$ decay is observed, while we fail to confirm the existence of the $\Sigma^+(3170)$.

7959 **New results on radiative J/psi decays from mark III.** Richman, J.D. (California Institute of Technology, Pasadena, California 91125). *AIP (American Institute of Physics) Conference Proceedings;* **121**: No. 1, 34-60(15 Oct 1984). Contract AC03-81ER40050.

Results from the analysis of five radiative J/psi decays are presented. In J/psi$\to\gamma$KK-bar, the f'(1515), θ(1720), and a new state, the ξ(2200), are observed in the KK-bar mass spectrum. In the double radiative decay J/psi$\to\gamma X;X\to\gamma p^0$, evidence is presented for structure near 1.4 GeV. Finally, in the three SU(3) related decays J/psi$\to\gamma$rho$\to$ rho^0, J/psi$\to\gamma$rho$^+$rho$^-$, and J/psi$\to\gamma\omega\omega$, structure is observed near 1.7 GeV. Analysis of the decay angular distributions in these three modes indicates that even spin and odd parity predominate in this mass region.

7960 **Recent particle searches at PEP.** Messner, R.L. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *AIP (American Institute of Physics) Conference Proceedings;* **121**: No. 1, 154-175(15 Oct 1984). Contract AC03-76SF00515.

The subject of this talk will be the recent searches for new particles that have been conducted at PEP. In such a context, PEP's unique advantage is a large integrated luminosity that has been accumulated in recent years. While the center of mass energy has remained at 29 GeV, experiments can perform clean, high statistics searches to set improved limits on new particle production.

6452 PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

REFER ALSO TO CITATION(S) 7942, 7979, 7988

7961 (BNL—37035) Stability and size of a chiral soliton immersed in nuclear matter. Kahana, S. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 11p. (CONF-8508140—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001185.

From Bates Users Theory Group workshop (BUTG); Cambridge, MA, USA (9 Aug 1985).

The alteration in nucleon substructure when nucleons are placed in nuclear matter is addressed in a Wigner-Seitz approximation by treating nuclei as a collection of chiral solitons. In the limit of strong coupling between quarks and the binding chiral fields, and for low density nuclear matter, it is found the solitons decrease slightly in size. 19 refs., 3 figs.

7962 (BNL—37066) ISAJET: a Monte Carlo event generator for pp and anti pp interactions. Paige, F.E.; Protopopescu, S.D. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 15p. (CONF-8506194—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86001202.

From International symposium on multiparticle dynamics; Kiryat Anavim, Israel (1 Jun 1985).

ISAJET is a Monte Carlo program which simulates pp and anti pp interactions at high energy. It is based on perturbative QCD plus phenomenological models for jet and beam jet fragmentation. This article describes ISAJET Version 5.00. 21 refs., 3 figs.

7963 (JINR—E-2-84-809) Proton decay cannot be suppressed kinematically. Dittrich, J.; Exner, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85703186.

Using a recently derived decay-law formula for relativistic unstable particles the effect of the size and shape of the wavepacket on the decay of a free proton is studied. For simplicity, the proton is assumed to be spherically symmetric and spinless. The decay probability is found to be lessened comparing to the theoretically expected one, however, the effect is insignificant under realistic experimental conditions. Hence the proton decay is not likely to be suppressed kinematically, contrary to the prediction of a paper by Fleming. 15 references, 2 figures.

7964 (LA-UR—85-3524) Hyperon-nucleon interaction and meson exchange. Buttgen, R.; Holinde, K.; Holzenkamp, B.; Speth, J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 17p. (CONF-850921—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002387.

From 5. international conference on hypernuclear and kaon physics; Upton, NY, USA (9 Sep 1985).

We present first results of our general program which is to construct meson-exchange potentials for hadronic systems involving stange particles, i.e. for KN and AN. We proceed along the same guidelines which have been successfully applied in deriving the (latest version of the) Bonn NN potential, namely to keep the important recoil and nonlocal structure and to use a comprehensive set of diagrams without introducing any fictitious contribution. For KN we show that single vector-meson (ω,p) exchange already provides a fair description of the data except for the isospin-1 P/sub 3/2/ wave. This partial wave is remarkably improved by adding a specific higher-order process involving ΔK intermediate states. For the ΛN system we demonstrate the inadequacy of a nonrelativistic treatment of the ΛN interaction and point to the strong interplay between K and K*-exchange in the tensor channel, which is even stronger than for π- and p-exchange in the NN system.

7965 (SLAC-PUB—3763) Toponium-Z^0 interference. Franzini, P.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1985. Contract AC03-76SF00515. 5p. (CONF-850869—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001458.

From Meeting of the Particles and Fields Division of the American Physical Society; Eugene, OR, USA (12 Aug 1985).

A study of interference of the Z^0 boson and toponium states is presented. The simple case of the Z^0 mixing with one t anti t state is discussed in detail. Effects of mixing with the full t anti t spectrum, of the smearing due to beam spread, and of different potentials, are then shown.

7966 (SLAC-PUB—3795) Aspects of meson-Skyrmion scattering. Mattis, M.P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1985. Contract AC03-76SF00515. 11p. (CONF-8508127—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002935.

From Nuclear chromodynamics conference; Santa Barbara, CA, USA (12 Aug 1985).

Model-dependent and model-independent results for $\pi N \rightarrow \pi N$ and $\pi N \rightarrow \pi\Delta$ in the Skyrme model are reviewed. An extension of the formalism to the 3-flavor case is presented. 28 refs., 5 figs.

7967 Jets in W and Z production from QCD showers. Barger, V.; Gottschalk, T.; Ohnemus, J.; Phillips, R.J.N. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review [Section] D: Particles and Fields;* **32**: No. 11, 2950-2953(1 Dec 1985). Contract AC02-76ER00881.

A QCD-shower Monte Carlo model is used to calculate n-jet production in association with W,Z bosons at the CERN pp-bar collider. The shower approach is unique in allowing complete predictions of all W, Z, and jet observables with no restriction to low orders. The results agree well with the observed distributions in P/sub T/(W,Z), jet multiplicity, jet E/sub T/, jet polar angle, and W+jet invariant mass.

7968 Validity of the coupled-channel method for the study of Δ excitation in intermediate-energy NN scattering. Lee, T.H.; Matsuyama, A. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **32**: No. 6, 1986-1989(Dec 1985). Contract W-31-109-ENG-38.

Within the unitary πNN theory with Δ excitation, the effect of πd and πNN production channels on NN elastic scattering is examined. It is shown that the two-body coupled-channel method, which has been widely employed to study the Δ excitation in intermediate-energy NN scattering, is a valid approximation. Our results indicate that the difficulty encountered by the meson-exchange theory in understanding the NN data up to 1 GeV cannot be resolved within the model based on the one-pion-exchange Δ excitation mechanism.

7969 Single-surface basis for topological particle theory. Chew, G.F.; Poenaru, V. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] D: Particles and Fields;* **32**: No. 10, 2683-2697(15 Nov 1985). Contract AC03-76SF00098.

Orientations of the embellished two-dimensional bounded manifold that embeds the Feynman graph in topological particle theory (TPT) are shown capable of representing all discrete particle properties; there is no need for a second surface. By recognizing more fully than heretofore the patch structure of the surface, a representation is found for quark generation and lepton generation as well as for spin-chirality. "Color" is given a representation similar to that found earlier for isospin. Previously developed representations of baryon number, electric charge, and "quark" chirality remain essentially unchanged. The proposed modifications of topological particle theory leave hadron dynamics unaltered while facilitating TPT extension to electroweak interactions.

7970 **Adiabatic expansion and higher-order corrections for induced currents.** Itoyama, H. (Department of Physics, Columbia University, New York, New York 10027). *Physical Review [Section] D: Particles and Fields;* **32**: No. 10, 2841-2842(15 Nov 1985).

A precise expression and adiabatic expansion for the induced fermion current are given, and then some terms are calculated in a simple model of polyacetylene. A possible nonlinear term that can appear in a higher order is absent.

7971 **Stop the top.** Hall, L.J.; Raby, S. (Harvard Univ., Cambridge, MA). *Physics Letters [Section] B;* **153**: No. 6, 433-438(11 Apr 1985).

The UA1 Collaboration has seen striking monojet events, and events consistent with a W->tanti b interpretation. We investigate whether supersymmetric scenarios invented to explain the monojet events can also explain the top candidate events. This is found to occur only for the squark pair production scenario. In a minimal N=1 supergravity model, both events occur only if parameters of the theory are chosen to be in certain ranges. Further implications and predictions are made.

7972 **Magnetic moment of W and the scale of composite weak bosons.** Suzuki, M. (Lawrence Berkeley Lab., CA). *Physics Letters [Section] B;* **153**: No. 4/5, 289-293(4 Apr 1985).

If the W boson is composite, its magnetic moment deviates from the value of the standard electroweak gauge theory. We derive some quantitative relations between this deviation and the scale of compositeness from partial-wave unitarity at high energies and from the anomalous magnetic moment of the muon. If the W magnetic moment differs from the standard value by one unit of e/2msub(W), for instance, the compositeness scale must be lower than about 1 TeV. An improvement in acccuracy of the measurement of the magnetic moment of the muon by another order of magnitude may lead us to a valuable insight into the compositeness scale of the W boson.

7973 **Bounds on charged Higgs properties from CP violation.** Athanasiu, G.G.; Gilman, F.J. (Stanford Linear Accelerator Center, CA). *Physics Letters [Section] B;* **153**: No. 4/5, 274-278(4 Apr 1985).

We examine bounds from CP violation in the neutral K system on charged Higgs masses and couplings in models with two Higgs doublets. While CP violation is still due only to a non-zero phase in the Kobayashi-Maskawa matrix, there are additional short-distance contributions involving charged Higgs exchange rather than W exchange. By having CP violation in the mass matrix, but not in K -> $\pi\pi$ decay amplitude, largely due to Higgs exchange, it is possible to obtain a small value of epsilon'/epsilon.

6453 PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

7974 **(LBL—20260) Experimental consequences of R-parity breaking.** Dawson, S. (Lawrence Berkeley Lab., CA (USA)). Sep 1985. Contract AC03-76SF00098. 10p. (CONF-850768—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002886.

From SLAC summer institute on particle physics; Stanford, CA, USA (23 Jul 1985).

We consider the consequences of R parity breaking in low energy super-aymmetric models. We discuss the new phenomenology expected in this class of models and compare it with the predictions of the R conserving supersymmetric theories. 7 refs., 1 fig.

7975 **Alternative extension of supersymmetry.** Staebler, G.M. (Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Physical Review [Section] D: Particles and Fields;* **32**: No. 10, 2604-2614(15 Nov 1985). Contract AS05-80ER10713.

Alternative extensions of supersymmetry in higher dimensions are explored. A general Weyl-spinor-type extension is found that becomes just N = 1 supersymmetry in 3+1 dimensions. In higher dimensions it can be broken to (N = 1 supersymmetry) x (internal group), where the internal group can easily contain the standard model. Off-shell superspace actions are constructed. The flat-space generalization of the Wess-Zumino action is quantized and shown to be ultraviolet finite to all orders, when in higher dimensions. An off-shell superspace action for supergravity based on the alternative supersymmetry is given, and some prospects for quantization and dimensional reduction of this action are discussed.

7976 **Note on CP nonconservation in K→$\pi\pi$.** Galic, H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **32**: No. 9, 2456-2457(1 Nov 1985). Contract AC03-76SF00515.

A semiphenomenological upper bound on the value phi$_{00}$-phi/sub +/- is derived and discussed.

7977 **Quark mixing phenomenonology: The b lifetime, ϵ'/ϵ, m/sub t/, and CP violation in heavy quark decays.** Chau, L. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings;* **121**: No. 1, 176-200(15 Oct 1984).

The present status of our knowledge on quark mixing and its phenomenologicl implications are reviewed. Especially, the implications of the recent measurements of the b lifetime and the ratio Γ/sub b/+u/Γ/sub b/+c on the Kobayashi-Maskawa matrix, CP violation in the K system ϵ, ϵ'/ϵ, t-quark masses m/sub t/, and the CP violating effects in charm and beauty particle decays are discussed.

6454 FIELD THEORY

REFER ALSO TO CITATION(S) 7893, 7895, 7969, 7972, 7975, 7977, 8035, 8066

7978 **(BNL—37129) Particle spin tune in a partially excited snake.** Lee, S.Y.; Tepikian, S.; Courant, E.D. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 4p. (CONF-8506173—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002507.

From Workshop on polarized beams at the SSC; Ann Arbor, MI, USA (10 Jun 1985).

In this paper, we address the question on the effect of the particle spin when a snake is turned on adiabatically near a depolarization resonance while not accelerating. The spinor equation and its solution are reviewed briefly and the spin transfer matrix method in the presence of a snake are used to evaluate the spin tune and the precession axis.

7979 **(DOE/ER/10336—7) Investigations in particle and field theory. Progress report, December 1, 1984-November 30, 1985.** Haller, K.; Islam, M.M.; Mannheim, P.D.; Caldi, D.C. (Connecticut Univ., Storrs (USA)). Nov 1985. Contract AC02-79ER10336. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003519.

Progress for the period December 1, 1984-November 30, 1985 is reported in the dynamics of gauge theory, topological features of gauge theory, lattice gauge theory, hadron dynamics, grand unified theories, and general field theory.

7980 **(DOE/ER/40033—102) [High energy physics]. Technical progress report, November 1, 1984-October 31, 1985.** Beg, M.A.B.; Khuri, N.N.; Pais, A. (Rockefeller Univ., New York (USA)). 1985. Contract AC02-81ER40033. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003520.

Progress in theoretical high energy physics is reported for the period from November 1, 1984 to October 31, 1985. Work reported includes gauge theories, quantum mechanics, and superstrings. 33 refs. (LEW)

7981 **(JINR—E-2-84-842) Problem of axial anomaly in supersymmetric gauge theories.** Kazakov, D.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 4p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85703204.

The explicit relation is found between the axial current obeying the Adler-Bardeen theorem and the supersymmetric one belonging to a supermultiplet. It is shown that the axial and superconformal anomalies are consistent in all orders of perturbation theory. 9 references.

7982 **(JINR—E-2-85-82) Bosonic and fermionic string models in the space of Lie groups.** Isaev, A.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1985. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85703205.

A two-dimensional model is considered which combines the features of the chief chiral field model with the Wess-Zumino term added and of the relativistic string model. The aim of this work was to investigate the dynamics of relativistic strings (bosonic and fermionic) in compact and noncompact Lie group spaces. The field theory methods and the inverse scattering method are employed. An auxiliary spectral problem for the considered boson theory in the Hamiltonian approach is constructed, and a generating functional for an infinite number of involutary conservation laws is obtained. For fermion theory quantum binding algebra has been studied for which central charges have been calculated. The obtained results indicate that the proposed theories generalize the known theories of relativistic strings. Thus, they could be used to construct the unified field theory. 15 references.

7983 **(JINR—E-11-84-495) Symmetry properties of some nonlinear field theory models.** Shvachka, A.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1984. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85703203.

Various approaches towards the study of symmetry properties of some nonlinear evolution equations as well as possible ways of their computer implementation using the computer algebra systems langage are discussed. Special attention is paid to the method of pseudopotential investigation of formal integrability and isovector method for the equations of balance. 67 references.

7984 **(LBL—20412) One-loop effective potential from compactified superstring models.** Gaillard, M.K. (Lawrence Berkeley Lab., CA (USA)). Oct 1985. Contract AC03-76SF00098. 5p. (CONF-850721—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002880.

From International Europhysics conference on high energy physics; Bari, Italy (18 Jul 1985).

A recent determination is reported of the one loop effective potential from the effective tree Lagrangian in models obtained from compactification of the zero-slope limit of superstring theories, both with and without induced terms conjectured to arise from nonperturbative effects in a hidden sector theory. In the absence of condensate effects, the vacuum structure of the tree potential is preserved by the one-loop radiative corrections. In the presence of supersymmetry breaking condensate effects at tree level, the gauge non-singlet scalars remain massless at the one-loop level. In this case the vacuum expectation value of Re t and therefore the gravitino mass are determined at one loop. Specifically, it is found that the gravitino mass, the condensate scale, and the grand unification scale must all lie within a few orders of the Planck scale. 14 refs. (LEW)

7985 **(SLAC-PUB—3794) σ model approach to the heterotic string theory.** Sen, A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1985. Contract AC03-76SF00515. 6p. (CONF-850798—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002936.

From Workshop on unified string theories; Santa Barbara, CA, USA (29 Jul 1985).

Relation between the equations of motion for the massless fields in the heterotic string theory, and the conformal invariance of the σ model describing the propagation of the heterotic string in arbitrary background massless fields is discussed. It is emphasized that this σ model contains complete information about the string theory. Finally, we discuss the extension of the Hull-Witten proof of local gauge and Lorentz invariance of the σ-model to higher order in α', and the modification of the transformation laws of the antisymmetric tensor field under these symmetries. Presence of anomaly in the naive N = 1/2 supersymmetry transformation is also pointed out in this context. 12 refs.

7986 **Microcanonical formulation of lattice gauge theories with fermions.** Iwazaki, A. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] D: Particles and Fields;* **32**: No. 10, 2756-2760(15 Nov 1985). Contract AC03-76SF00098.

We present a microcanonical formulation of SU(N/sub c/) lattice gauge theories with fermions. In this formulation correlation functions are given by a microcanonical ensemble average of bosonic fields. By use of the weak-coupling expansion, we prove the equivalence between this formulation and the standard functional formulation. The standard Schwinger-Dyson equations can be found to hold in this formulation.

7987 **Gauge fixing the SU(N) lattice-gauge-field Hamiltonian.** Baaquie, B.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **32**: No. 10, 2774-2779(15 Nov 1985). Contract AC03-76SF00515.

We exactly gauge fix the Hamiltonian for the SU(N) lattice gauge field and eliminate the redundant gauge degrees of freedom. The gauge-fixed lattice Hamiltonian, in particular for the Coulomb gauge, has many new terms in addition to the ones obtained in the continuum formulation.

7988 **Degenerate states and the Kinoshita-Lee-Nauenberg theorem in deep-inelastic scattering.** Axelrod, A.; Nelson, C.A. (Department of Physics, Florida State University, Tallahassee, Florida 32306). *Physical Review [Section] D: Particles and Fields;* **32**: No. 9, 2385-2395(1 Nov 1985).

A variation of the QCD parton model is proposed in which the partons are identified with nearly degenerate quark-gluon states. This relies only on the Kinoshita-Lee-Nauenberg theorem to cancel infrared singularities. In deep-inelastic scattering, incoming quark states are replaced by degenerate "jet" states and the Bjorken x variable is reinterpreted to be the momentum fraction of a "jet" in a hadron. Calculations of the full O(α/sub s/) corrections are then done for the nonsinglet structure functions and for the associated nonsinglet operator matrix elements. In both quantities, the soft infrared singularities cancel and the collinear singularities cancel. Thus the proposal has been implemented. By the operator-product expansion the associated coefficient function is obtained and it is the usual one.

7989 **Nuclear alignment: Implications for the decay of the quantum-electrodynamic vacuum.** Oberacker, V.E. (Department of Physics, Vanderbilt University, Nashville, Tennessee 37235). *Physical Review [Section] C: Nuclear Physics;* **32**: No. 5, 1793-1795(Nov 1985). Contract AS05-84ER40137.

For the long time delay apparently needed for the spontaneous decay of the quantum-electrodynamic vacuum in reactions of very heavy ions (U+U, U+Cm), it is necessary that the deformed nuclei collide with a well-defined orientation. Because of dynamic orientation of the nuclear quadrupole moments, the probability for "favorable" alignment is calculated to be only about one percent. Implications for observing the vacuum decay are discussed.

7990 **Nonlinear models in 2+epsilon-c dimensions.** Friedan, D.H. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Annals of Physics (New York);* **163**: No. 2, 318-419(Sep 1985). Contract W-7405-ENG-48.

The general nonlinear scalar model is studied at asymptotically low temperature near two dimensions. The low temperature expansion is renormalized and effective algorithms are derived for calculation to all orders in the renormalized expansion. The renormalization group coefficients are calculated in the two loop ap-

proximation and topological properties of the renormalization group equations are investigated. Special attention is paid to the infrared instabilities of the fixed points, since they provide the continuum limits of the model.

7001 **Baryon-number violation induced by the monopoles of the Pati-Salam model.** Sen, A. (Fermi National Accelerator Lab., Batavia, IL). *Physics Letters [Section] B;* **153**: No. 1/2, 55-58(21 Mar 1985).

We study the possible baryon-number violating effects induced by the monopoles that are formed due to the spontaneous breakdown of the Pati-Salam group [SU(2)sub(L) x SU(4)]. This effect is due to the weak 't Hooft anomaly. Although the baryon-number violating condensates involving only the first and the second generation fermions are suppressed by powers of mixing angles, we show that all the relevant mixing angles may be large, while still being consistent with the smallness of the Kobayashi-Maskawa mixing angles. Hence the baryon-number violating effects caused by such monopoles need not be suppressed.

6455 SCATTERING THEORY

7002 **Discretizing the three-body continuum: bound states and two-body amplitudes.** Kuruoglu, Z.C.; Levin, F.S. (Physics Department, Brown University, Providence, Rhode Island 02912). *Annals of Physics (New York);* **163**: No. 1, 120-148(Aug 1985).

In this paper, we use a soluble model to investigate the accuracy of a discretization approximation for calculating bound states and two-body collision parameters. The model is that of three identical particles interacting via short-range, separable, S-wave pair potentials. Both weakl;y (spin-quartet fermion) and strongly (boson) interacting systems are examined. Discretization is achieved by diagonalizing the Hamiltonian for the two-particle subsystems in a finite set of L^2 functions, here chosen to be Laguerre polynomials. By requiring that the energy and eigenfunction of the lowest-lying member of the resulting set of pseudostates be in excellent agreement with the actual bound-state energy and eigenfunction of the two-particle Hamiltonian, this method discretizes the three-particle continuum, replacing it with a set of two-body continua corresponding to pseudo-inelastic scattering.

7003 **Discretizing the three-body continuum: Interpretation of non-breakup results.** Adhikari, S.K.; Kuruoglu, Z.C.; Levin, F.S. (Departamento de Fisica, Universidade Federal de Pernambuco, 50000 Recife, Pe, Brazil). *Annals of Physics (New York);* **163**: No. 1, 149-166(Aug 1985).

This paper is concerned with understanding the physics responsible for the major result of the preceding article, viz., that the coupled reaction channel (CRC) ansatz responds better than any of the connected-kernel (exact) collision theories to an L^2 (pseudostate) discretization approximation. The analysis is carried out within the framework of the wave function equations equivalent to the transition operator formalisms employed in the preceding article. In an alternate approach comparing the CRC method with an approximate version of a multichannel collision theory, it was argued that since only the CRC ansatz is based directly on the Schroedinger equation and on orderly restrictions of the Hilbert space, then it must be the superior approximation. While this conclusion is correct, the argument underlying it is in fact inadequate. The different argument used in the present analysis is based on the fact that connected-kernel theories require contributions from the full three-body breakup continua in order to determine the two-body transition amplitudes accurately, while the effect of an L^2 discretization approximation on them is to eliminate much of these contributions unless very high-lying pseudostates are employed. In contrast, high-lying pseudostates are much less important for the CRC case. This is demonstrated and its ramifications are explored in some detail herein. In particular, the analyses based on this argument are seen to yield an understanding and interpretation of almost all of the trends exhibited in the results tabulated in the preceding article.

65 PHYSICS II

6510 NUCLEAR PHYSICS

7004 **(ANL—85-22) Physics Division annual review, 1 April 1984-31 March 1985.** (Argonne National Lab., IL (USA)). Sep 1985. Contract W-31-109-ENG-38. 276p. NTIS, PC A13/MF A01; GPO Dep. File Number DE86002650.

Separate abstracts were prepared for individual sections in this annual report of the Physics Division of Argonne National Laboratory. Many diverse topics of research were discussed. Among these were topics of medium-energy research such as a study of non-nucleonic effects in nuclei, two-nucleon physics with pions and electrons, nuclear structure studies and weak interaction studies. Research efforts which were performed at the superconducting Linac accelerator were studies of fusion of heavy ions, investigation of quasielastic and strongly damped collisions, studies of high angular momentum states in nuclei, accelerator mass spectrometry, and nuclear spectrometry. Atomic and molecular research programs included photoionization-photoelectron studies, high-resolution laser spectroscopy with beams, beam foil studies, and studies of interactions of beams with solids and gases. Theoretical endeavors were carried out in both atomic physics and nuclear physics. (WRF)

7005 **(BNL—37159) N/sub p/.N/sub n/ systematics and their implications.** Casten, R.F. (Koeln Univ. (Germany, F.R.). Inst. fuer Kernphysik; Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 7p. (CONF-850942—36). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002926.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

A substantial simplification of the systematics in nuclear phase transition regions is obtained if the data are plotted against the product, N/sub p/.N/sub n/, of the number of valence protons and neutrons instead of against N, Z, or A as is usually done. Such a scheme leads to a unified view of nuclear transition regions and to a simplified scheme for collective model calculations. 7 refs., 5 figs.

7006 **Recent references.** Ramavataram, S. (Brookhaven National Laboratory, Upton, New York 11973). *Nuclear Data Sheets;* **46**: No. 3, 379-379(Nov 1985). Contract AC02-76CH00016.

An index is given of journal articles dealing with nuclear reactions of nuclear structure. Literature received by the National Nuclear Data Center or assigned key numbers between May and August 1985 is covered. (AIP)

6511 EXPERIMENTAL TECHNIQUES

7007 **(DOE/ER/40098—1) Nuclear moments of radioactive nuclei. Final report.** Greenlees, G.W. (Minnesota Univ., Minneapolis (USA). Dept. of Physics). 1985. Contract AC02-83ER40098. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003533.

An unsuccessful attempt was made to study nuclear moments of radioactive nuclear using laser spectroscopy. Although preliminary tests had indicated a sensitivity sufficient to observe signals of fluxes less than one atom/s no resonance fluorescence was detected. Activity measurements showed several hundred nuclei per second were in the beam; therefore it was postulated that, due to the the reactivity of the ^{136}Ba and sodium used, contaminants were the probable source of negative results. 3 refs., 2 figs. (WRF)

6512 NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

7998 (INIS-mf—9947, pp 25-26) **Calculation of the energy spread of 14 meV neutrons from the T(D, N)^{4}He reaction.** Pavlik, A.; Winkler, G. (Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Radiumforschung und Kernphysik). 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85702930.

Published in summary form only.

In Progress report 1984.

7999 **Trinucleon magnetic moments.** Tomusiak, E.L.; Kimura, M.; Friar, J.L.; Gibson, B.F.; Payne, G.L.; Dubach, J. (Saskatchewan Accelerator Laboratory and Department of Physics, University of Saskatchewan, Saskatoon, Saskatchewan, Canada S7N 0W0). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 6, 2075-2086(Dec 1985).

Impulse approximation and pion-exchange current contributions to the trinucleon magnetic moments are calculated using wave functions generated by solving the configuration-space Faddeev equations for a variety of nucleon-nucleon force models. Careful attention is paid to the origin of important exchange current contributions. Numerical results are compared with previously published calculations and with the experimental data. An attempt is made to isolate and understand sources of discrepancy between our results and those previously published. Calculations which include both impulse and pion-exchange current contributions are in fairly good agreement with experiment, whereas calculations which include only the impulse approximation term are not.

8000 **^{3}H(p,γ) ^{4}He reaction at E/sub p/ = 9.0 MeV.** Wagenaar, D.J.; Roberson, N.R.; Weller, H.R.; Tilley, D.R. (Duke University and Triangle Universities Nuclear Laboratory, Duke Station, Durham, North Carolina 27706). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 6, 2155-2157(Dec 1985). Contract AC05-76ER01067.

Angular distributions of cross section and analyzing power were measured for the ^{3}H(p,γ) ^{4}He reaction at E/sub p/ = 9.0 MeV. A transition matrix element analysis including E1 and E2 terms showed the triplet electric quadrupole (^{3}D$_2$) amplitude to be larger than predicted by shell model or direct capture calculations. It is shown that the inclusion of M2 terms in the T-matrix element analysis does not reduce the ^{3}D$_2$ amplitude, but that the inclusion of E3 terms does.

8001 **Molecular effects in tritium β decay. II. Rotation-vibration excitation, dissociation, and rotational predissociation in the decay of the T$_2$ and TH molecules.** Jeziorski, B.; Kolos, W.; Szalewicz, K.; Fackler, O.; Monkhorst, H.J. (Quantum Theory Project, Departments of Physics and Chemistry, University of Florida, Gainesville, Florida 32611; Department of Chemistry, University of Warsaw, Pasteura 1, 02 093 Warsaw, Poland; Department of Applied Mathematics, University of Waterloo, Waterloo, Ontario, Canada N2L3G1). *Physical Review* [*Section*] *A: General Physics;* **32**: No. 5, 2573-2583(Nov 1985). Contract W-7405-ENG-36.

Probabilities have been computed for transitions induced by a β-decay process from the ground rovibronic state of the T$_2$ molecule to various bound rovibrational and scattering states connected with the first six $^1\Sigma^+$ electronic states of the ^{3}HeT$^+$ ion. Analogous calculations were performed for the TH source but only the ground electronic state of the daughter system was considered. For transitions from the T$_2$ source to the ground electronic state of the daughter ion a probability equal to 0.4083 is associated with bound rovibrational states while 0.1659 is associated with scattering states. The same values for the TH source are 0.5572 and 0.0136, respectively. It is shown that the use of a TH source is not advantageous in a neutrino-mass experiment. Numerical accuracies of our calculations have been checked by making extensive use of sum rules. The total error in the final result is discussed.

6513 NUCLEAR PROPERTIES AND REACTIONS, A=6-19, THEORETICAL

8002 **(DOE/ER/03948—T2) Experiments on Σp hypernuclei with in flight kaons.** Hungerford, E.V. (Houston Univ., TX (USA). Dept. of Physics). 1985. Contract AS05-76ER03948. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003458.

This brief discussion will present some new data on Σ hypernuclei taken at Brookhaven National Laboratory's Alternating Gradient Synchrotron (AGS) using the hypernuclear spectrometer. While analysis of the data is not fully completed, it is sufficient to draw several interesting conclusions. 11 refs., 8 figs.

8003 **(LA-UR—85-3825) Associated production of hypernuclei.** Peng, J.C. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 18p. (CONF-850921—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001698.

From 5. international conference on hypernuclear and kaon physics; Upton, NY, USA (9 Sep 1985).

The characteristics of the (π^+,k$^+$) reaction, a new experimental tool to produce hypernuclei, are discussed. Results from a recent (π^+,k$^+$) experiment are presented. Some future prospects of the (π^+,k$^+$) reaction are discussed. 31 refs., 12 figs.

8004 **Coulomb energy systematics and the missing J/sup π/ = (1/2)$^+$ state in ^{9}B.** Sherr, R.; Bertsch, G. (Department of Physics, Princeton University, Princeton, New Jersey 08544). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 6, 1809-1816(Dec 1985).

We study the energy systematics in light mirror nuclei of the unbound states having predominant single-particle character. For many levels in the mass range A = 9—17, the observed Thomas-Ehrmann shift is described very well by a simple potential model. We speculate that the missing partner in ^{9}B of the (1/2)$^+$ state in ^{9}Be is observable as a broad continuum with a peak at 0.9 MeV.

8005 **Cross sections relevant to gamma-ray astronomy: Alpha-particle-induced reactions on ^{12}C, ^{14}N, and ^{16}O nuclei.** Dyer, P.; Bodansky, D.; Leach, D.D.; Norman, E.B.; Seamster, A.G. (Heavy Ion Laboratory, Michigan State University, East Lansing, Michigan 48824 and Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 6, 1873-1881(Dec 1985).

Gamma-ray production cross sections have been measured for the gamma-ray lines most strongly excited in the alpha-particle bombardments of ^{12}C, ^{14}N, and ^{16}O for alpha-particle energies from threshold to 27 MeV. Tabulations of cross sections averaged over alpha-particle energy bins of 1 MeV are provided for calculations relevant to gamma-ray line astronomy. Relevance to analysis of spectra acquired with gamma-ray spectrometers in space is discussed.

8006 **Search for a direct large-cluster-transfer process in the /sup 12,13/C(^{20}Ne,α) reaction.** Murakami, T.; Takahashi, N.; Lui, Y.; Takada, E.; Tanner, D.M.; Tribble, R.E.; Ungricht, E.; Nagatani, K. (Cyclotron Institute, Texas A&M University, College Station, Texas 77843). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 6, 2161-2164(Dec 1985).

The /sup 12,13/C(^{20}Ne,α) reactions were measured at E = 140.2 MeV in order to search for a direct ^{16}O-cluster-transfer process. In the reaction with the ^{12}C target, prominent broad peaks were observed, while the spectrum with the ^{13}C target shows a smooth continuum with much smaller structures in the high excitation region. Kinematics of the structures in the ^{12}C(^{20}Ne,α) reaction demonstrates that most of them do not arise from a large cluster transfer, but rather they originate from a sequential ejectile decay.

8007 **Large-angle elastic scattering of πi and π^- from ^{16}O at 114 MeV.** Dhuga, K.S.; Burleson, G.R.; Faucett, J.A.; Boudrie, R.L.; Cottingame, W.B.; Greene, S.J.; Morris, C.L.; Tanaka, N.; Wang, Z.F.; Nanda, S. (New Mexico State University, Las Cruces, New Mexico 88003). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 6, 2208-2211(Dec 1985).

Elastic cross sections have been measured for the scattering of π^+ and π^- from ^{16}O at 114 MeV in the angular range of 115° to 175° (c.m.). Large cross sections and large π^+/π^- differences have been observed beyond 140° (c.m.). First-order optical model calculations fail to reproduce the large-angle data. Second-order effects generally improve the fits, but the details of the present data together with the results of earlier measurements at smaller angles have not been satisfactorily explained.

8008 **Spin observables in quasi-elastic proton-nucleus scattering near 1 GeV.** Smith, R.D.; Wallace, S.J. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 5, 1654-1666(Nov 1985).

The spin dependence of quasi-elastic proton-nucleus scattering is studied using Glauber's eikonal multiple scattering theory, which is extended to include multiple knockout collisions as well as the full spin dependence of the NN amplitudes. Calculations of the cross section $d^2\sigma/d\Omega$ dp and spin observables DNN, DLL, DSS, DSL, DLS, Ay are presented and compared to data for $d^2\sigma/d\Omega$ dp and Ay from inclusive (p,p') experiments on ^{12}C at T/sub lab/ = 800 MeV. The main feature seen is a drop in the spin observables in the kinematic region where two nucleon knockout dominates the cross section. As an initial study of the contribution of quasi-free Δ production to the inclusive cross section, multiple scattering theory is used to normalize a plane-wave impulse approximation calculation of $d^2\sigma/d\Omega$ dp for p+ ^{12}C→p+π+ ^{12}C(. .AE

6514 NUCLEAR PROPERTIES AND REACTIONS, A=20-38, THEORETICAL

8009 **Beta-delayed proton decays of ^{27}P and ^{31}Cl: Gamow-Teller decays with large Q values.** Aysto, J.; Xu, X.J.; Moltz, D.M.; Reiff, J.E.; Cerny, a.J.; Wildenthal, B.H. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 5, 1700-1706(Nov 1985). Contract AC03-76SF00098.

The beta-delayed proton emissions of the odd-Z, T/sub z/ = -(3/2) nuclei ^{27}P and ^{31}Cl have been studied. This work represents the first observation of the decay of ^{27}P, yielding a half-life of 260 +- 80 ms, and completes the series of beta-delayed proton emitters with T/sub z/ = -(3/2) in the sd shell. Several new proton groups were attributed to the decay of ^{31}Cl; their half-lives are consistent with a previous observation. The estimated logft values of the observed transitions for both ^{27}P and ^{31}Cl are consistent with clustering of the beta strength above the isobaric analog states in the daughter nuclei as predicted by a complete (1s,0d)-space shell-model calculation. The observed half-lives are in good agreement with the shell-model predictions which include a quenching of the Gamow-Teller strength by a factor of 0.6, in accordance with earlier observations.

6515 NUCLEAR PROPERTIES AND REACTIONS, A=39-58, THEORETICAL

8010 **Momentum balance for the incomplete fusion of ^{16}O+ ^{40}Ca.** Budzanowski, A.; Dabrowski, H.; Chan, Y.; Stokstad, R.G.; Tserruya, I.; Wald, S. (Institute of Nuclear Physics, Cracow, Poland). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 5, 1534-1538(Nov 1985). Contract AC03-76SF00098.

The velocities of fusion-like residues produced at 15° in the reaction 313 MeV ^{16}O+ ^{40}Ca have been measured in coincidence with alpha particles emitted over a wide range of angles. The maximum of the residue velocity distribution depends on the energy and angle of emission of the alpha particle. Analysis of this dependence indicates that a significant portion of the fast alpha particles at forward angles results from the fusion of ^{8}Be and the associated production of a ^{8}Be ejectile.

8011 **Measured activation cross sections below 10 MeV for the ^{51}V(n,p)^{51}Ti and ^{51}V(n,α)^{48}Sc reactions.** Smith, D.L.; Meadows, J.W.; Kanno, I. (Argonne National Lab., IL (USA)). *Annals of Nuclear Energy;* **11**: No. 12, 623-627(1984).

The activation method is used to measure cross sections for the ^{51}V(n,p)^{51}Ti reaction from Esub(n)=2.856 to 9.267 MeV and for the ^{51}V(n,α)^{48}Sc reaction from 5.515 to 9.567 MeV. Both measurements utilize ENDF/B-V evaluated neutron-induced fission cross sections of ^{235}U as a standard. The experimental results from this work are compared with corresponding ENDF/B-V evaluated cross sections for V and substantial differences are evident. The most significant difference is a tendency for the measured values to exceed evaluated ones by as much as 50% in the vicinity of 8 MeV.

6516 NUCLEAR PROPERTIES AND REACTIONS, A=59-89, THEORETICAL

8012 (ORNL—6120, pp 22-119) **Experimental nuclear physics.** Jan 1985. NTIS, PC A13/MF A01. File Number DE85006958.

In Physics Division progress report for period ending September 30, 1984.

The main research program in heavy-ion physics is carried out using the beams and equipment at HHIRF. Use is also made of heavy-ion facilities at LBL, Michigan State University and at Texas A and M. An extension of this program into the field of relativistic heavy-ion reactions is being pursued through a collaborative experiment to utilize 800 GeV to 3200 GeV ^{16}O beams at CERN. In addition, the authors continue to carry out a vigorous and productive program in medium energy physics using facilities at LAMPF, TRIUMF, and IUCF and a smaller program in neutron physics using the ORELA facility. Noteworthy accomplishments for this period include: new results from the Spin Spectrometer on neutrons and γ decay from giant resonances; the appearance of a quasivibrational transition in ^{158}Yb above spin 24h; further measurements on π^0 production from heavy-ion collisions; and the measurement of time-delayed processes from ^{16}O + Ge reactions using the crystal blocking technique.

8013 **Band structure in ^{81}Y and its radioactive decay.** Lister, C.J.; Moscrop, R.; Varley, B.J. (Manchester Univ. (UK). Dept. of Physics); Price, H.G. (Daresbury Lab. (UK)); Warburton, E.K.; Olness, J.W. (Brookhaven National Lab., Upton, NY (USA)); Becker, J.A. (Lawrence Livermore National Lab., CA (USA)). *Journal of Physics G: Nuclear Physics;* **11**: No. 8, 969-979(Aug 1985).

Bands of states in ^{81}Y have been identified by using a particle-gamma coincidence technique following the ^{58}Ni(^{28}Si, αp)^{81}Y reaction at beam energies of 80-130 MeV. A probable sequence of spins for the states is presented, and these data are compared with systematic trends in this region. The data indicate that the nucleus has a large prolate deformation. The radioactive decay of ^{81}Y to ^{81}Sr was reinvestigated by interrupting the beam and observing the population of states in ^{81}Sr.

6517 NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

8014 **(BNL—37198) Decay of ^{145}Cs to levels of ^{145}Ba.** Robertson, J.D.; Faller, S.H.; Walters, W.B.; Zganjar, E.F.; Gill, R.L.; Mach, H.; Piotrwoski, A.; Dejbakhsh, H.; Petry, R.F. (Brookhaven National Lab., Upton, NY (USA); Maryland Univ., College Park (USA). Dept. of Chemistry; Louisiana State Univ., Baton Rouge (USA). Dept. of Physics; Texas A and M Univ., College Station (USA). Cyclotron Lab.; Oklahoma Univ., Norman (USA)). 1985. Contract AC02-76CH00016. 6p. (CONF-850942—41). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003637.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

An investigation of the β^- decay of the 0.59s ^{145}Cs was made at the TRISTAN on-line mass separation facility. The level scheme for ^{145}Ba has been constructed. The proposed spin and parity assignments are based upon transition multipolarities and ∂-∂ angular correlation measurements. 16 refs., 1 fig., 2 tabs.

8015 (DOE/ER/03346—263) Decay of ^{138}Eu, ^{136}Eu and deformation in the light Sm region. Mlekodaj, R.L.; Braga, R.A.; Kern, B.D.; Leander, G.A.; Toth, K.S.; Gnade, B. (Oak Ridge Associated Universities, Inc., TN (USA); Georgia Inst. of Tech., Atlanta (USA). School of Chemistry; Kentucky Univ., Lexington (USA); Oak Ridge National Lab., TN (USA); Texas Instruments, Inc., Dallas (USA)). 1985. Contract AC05-84OR21400;AC05-76OR00033;AS05-76ER03346. 6p. (CONF-850942—33; ORO—3346-263). NTIS, PC A02/MF A01; GPO Dep. File Number DE86001895.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

The remote region of deformation in the very light rare earth region has been investigated by observation of the decay of ^{138}Eu and ^{136}Eu. These nuclei were produced with ^{40}Ti beams incident on ^{92}Mo targets and mass separated on-line at the UNISOR facility. Fifteen gamma rays associated with a 12 +- 1 s activity attributed to ^{138}Eu decay have been identified and ten of these placed in a decay scheme. The 2+→0+ transition in ^{136}Sm has also been identified. These results are compared to IBM2 and cranking model predictions.

8016 Emission of ^{3}He and ^{4}He in reactions of 70- and 160-MeV π^{+-} mesons with Ag. Kaufman, S.B.; Wilkins, B.D.; Henderson, D.J.; Green, R.E.L.; Korteling, R.G.; Butler, G.W. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **32**: No. 6, 1977-1985(Dec 1985). Contract W-31-109-ENG-38.

Energy spectra of ^{3}He and ^{4}He emitted in the reactions of 70- and 160-MeV π^{+-} mesons with Ag were measured at seven angles with respect to the beam, from 30° to 160°. The spectra are similar in both shape and magnitude to the corresponding spectra observed at an angle of 90° in the reactions of 300—480 MeV protons with the same target. The spectra from π^{+-} reactions are nearly independent of angle, in contrast to the strong angular dependence of the high-energy particles observed in reactions of protons and other projectiles. These observations, as well as the π^+/π^- ratios for the yields of ^{3}He and ^{4}He, are interpreted in terms of pion absorption and subsequent interactions of the resulting fast nucleons leading to fragment emission.

6518 NUCLEAR PROPERTIES AND REACTIONS, A=150-189, THEORETICAL

8017 (LA-UR—85-3664) Is it possible to induce a fast de-excitation of the 16$^+$ isomeric state in ^{178}Hf. Hsu, H.H.; Doolen, G.D.; Talbert, W.L.; Mack, J.M. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 14p. (CONF-8510137—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002412.

From International workshop on nuclear structure at high spin, high excitation, and high momentum transfer; Spencer, IN, USA (21 Oct 1985).

The 16$^+$ level of ^{178}Hf at 2.446 MeV is interpreted as a four-quasi-particel state with K = 16. It decays mainly to a 13$^-$ level at 2.433 MeV, a member of rotational band built on a two-quasi-particle 8$^-$ state (K = 8) at 1.1474 MeV. The 13-keV transition is > 99% E3 character and occurs predominantly through internal conversion. The five-times K-forbidden E3 transition has a large hindrance factor; the half-life of the 16$^+$ state is known to be 31 years. If this isomeric nucleus can be induced to release its energy quickly, the resulting energy release would be 6 orders of magnitude more energetic per reaction than that for existing high explosives. The following mechanisms to enhance de-excitation of this isomer are presented for discussion: (1) inelastic scattering of high-energy neutrons; (2) inelastic scattering of a high-energy, high-intensity electron beam; and (3) interaction with intense photon fields (rf, laser, x ray, γ ray). Experiments to explore such de-excitation mechanisms are discussed. 12 refs., 4 figs., 1 tab.

8018 Neutron emission in inelastic reactions of ^{12}C+ ^{156}Gd and ^{20}Ne+ ^{150}Nd. Petitt, G.A.; Gavron, A.; Beene, J.R.; Cheynis, B.; Ferguson, R.L.; Obenshain, F.E.; Plasil, F.; Young, G.R.; Jaeaeskelaeinen, M.; Sarantites, D.G. (Department of Physics and Astronomy, Georgia State University, Atlanta, Georgia 30303). *Physical Review [Section] C: Nuclear Physics;* **32**: No. 5, 1572-1583(Nov 1985).

Energy spectra and angular distributions of neutrons emitted in coincidence with projectilelike fragments produced in inelastic collisions of ^{12}C with ^{156}Gd at 192 MeV and ^{20}Ne with ^{150}Nd at 176 and 239 MeV have been measured. No evidence for nonequilibrium neutron emission is found for the Ne+Nd reaction at either energy. For the C+Gd reaction a small fraction (~9%) of the neutrons emitted is due to nonequilibrium emission. The multiplicity of neutrons emitted from the targetlike fragment is, in all cases, approximately six times that of neutrons emitted from the projectile-like fragment.

8019 Nuclear data sheets for A = 160*. Lee, M.A.; Buntings, R.L. (Idaho National Engineering Laboratory, EG&G Idaho Inc., Idaho Falls 83415). *Nuclear Data Sheets;* **46**: No. 2, 187-286(Oct 1985).

The experimental results from the various reaction and decay studies leading to nuclides in the A = 160 mass chain have been reviewed. These data are summarized and presented, together with the adopted level schemes and properties.

6519 NUCLEAR PROPERTIES AND REACTIONS, A=190-219, THEORETICAL

8020 (UCRL—90792) Study of heavy element structure with in-beam αp, β^- and γ-ray spectroscopy. Meyer, R.A.; Decman, D.J.; Henry, E.A.; Hoff, R.W.; Mann, L.G.; Struble, G.L.; Ussery, L.E. (Lawrence Livermore National Lab., CA (USA)). 10 May 1984. Contract W-7405-ENG-48. 27p. (CONF-840530—11). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86002619.

From International symposium on in-beam nuclear spectroscopy; Debrecen, Hungary (14 May 1984).

We describe our in-beam superconducting conversion electron spectrometer and its use in a (t,p) proton-conversion electron coincidence mode. Several examples of completed and on-going investigations are presented. These include: E0 strength from the ^{238}U fission isomer; electromagnetic properties of the J/sup π/ = 6$^+$ and 8$^+$ states of ^{210}Pb; single particle and cluster states of ^{213}Fr; the J/sup π/ = 21/2$^+$ isomer in ^{197}Au and ^{199}Au; and the cluster states of ^{199}Au. Results of the study of odd-odd deformed ^{244}Am are presented. The latter results performed using neutron-capture gamma-ray and conversion electron techniques are compared to recent developments in the modeling of deformed odd-odd nuclei. 23 refs., 10 figs., 1 tab.

8021 Level structure of ^{220}Ra. Shriner J.F. Jr.; Cottle, P.D.; Ennis, J.F.; Gai, M.; Bromley, D.A.; Olness, J.W.; Warburton, E.K.; Hildingsson, L.; Quader, M.A.; Fossan, D.B. (A.W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511). *Physical Review [Section] C: Nuclear Physics;* **32**: No. 6, 1888-1896(Dec 1985).

A level scheme for ^{220}Ra is presented, established using the ^{208}Pb(^{14}C,2n) reaction studied near the Coulomb barrier (60< or =E< or =68 MeV). Measurements included γ-ray excitation functions, γ-γ coincidences, and γ-ray angular distributions. The dominant features in the spectrum are states of alternating parity connected by fast E1 transitions. Values of B(E1)/B(E2) are obtained for states with J = 6—17 h. Examination of the systematic behavior of even-even Ra isotopes reveals a sharp change in structure as one proceeds from ^{214}Ra to ^{220}Ra. Results are discussed in terms of alpha-particle clustering (in particular as described by the vibron model) and of a stable octupole deformation; calculations of the energy spectrum based on the vibron model are presented.

6520 NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

REFER ALSO TO CITATION(S) 7989

8022 **(CONF-850942—40) Fast electric dipole transitions in Ra-Ac nuclei.** Ahmad, I. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003056.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

Lifetime of levels in ^{225}Ra, ^{225}Ac, and ^{227}Ac have been measured by delayed coincidence techniques and these have been used to determine the E1 gamma-ray transition probabilities. The reduced E1 transition probabilities. The reduced E1 transition probabilities in ^{225}Ra and ^{225}Ac are about two orders of magnitude larger than the values in mid-actinide nuclei. On the other hand, the E1 rate in ^{227}Ac is similar to those measured in heavier actinides. Previous studies suggest the presence of octupole deformation in all the three nuclei. The present investigation indicates that fast E1 transitions occur for nuclei with octupole deformation. However, the studies also show that there is no one-to-one correspondence between E1 rate and octupole deformation. 13 refs., 4 figs.

8023 **(CONF-8509147—11) Heavy isotope production by multinucleon transfer reactions with ^{254}Es.** Schaedel, M.; Bruechle, W.; Bruegger, M.; Gaeggeler, H.; Moody, K.J.; Schardt, D.; Suemmerer, K.; Hulet, E.K.; Douran, A.D.; Dougan, R.J. (Lawrence Livermore National Lab., CA (USA); Oak Ridge National Lab., TN (USA); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). 1985. Contract W-7405-ENG-48;AC05-84OR21400. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002223.

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

Fast automated on-line and quasi-on-line radiochemical techniques were applied to search for new isotopes, to measure their decay characteristics, and to study the cross sections of the heaviest, most neutron-rich actinide isotopes in reactions of /sup 16,18/O and ^{22}Ne projectiles with ^{254}Es as a target. The measured yields for isotopes up to Lr-260 are three or more orders of magnitude higher than in any other reaction used so far. A comparison with data for similar transfers from ^{248}Cm targets is made. Transfer cross sections are extrapolated for the production of unknown, neutron-rich isotopes of elements 101 through 105, and the unique potential of ^{254}Es as a target to make these exoctic nuclei accessible is demonstrated. 18 refs., 2 figs., 1 tab.

8024 **(DOE/OT/21400—T8) U-234 specific alpha activity.** Knight, G.B.; Goldin, A.S.; Macklin, P.A.; Macklin, R.L. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 8 Dec 1948. Contract AC05-84OT21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003596.

The spicific alpha activity of U-234 was determined using pure samples grown from UX. The half-life was found to be 2.67 +- 0.04 (L.E.) x 10^5 yr. The corresponding weight fraction in natural uranium was found to be 0.0000584 +- 0.0000008. 4 tabs.

8025 **(DOE/OT/21400—T9) Half-life of UX_1 (Th-234).** Knight, G.B.; Macklin, R.L. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1 Apr 1948. Contract AC05-84OT21400. 4p. (K—203). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003595.

The half-life of UX_1 was carefully redetermined and found to be 24.101 not equal 0.025 days.

8026 **(LBL—20300) Leap to produce heavy nuclei at the limits of nuclear stability.** Hoffman, D.C. (Lawrence Berkeley Lab., CA (USA)). Sep 1985. Contract AC03-76SF00098. 8p. (CONF-850942—39). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002887.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

The Large Einsteinium Activation Program (LEAP) has been proposed by a consortium of four national laboratories. Central to the proposal is the preparation, for the first time, of a large target of Es-254 in order to accomplish a unique scientific program. Progress and activities to date and plans for the future are discussed. 14 refs., 5 figs., 3 tabs.

8027 **(PINSTECH—104) Gamma ray transitions in de-excitation of ^{252}Cf spontaneous fission fragments.** Khan, N.A.; Rashid, K.; Ahmad, M.; Qureshi, I.E.; Alam, G.D.; Ali, A.; Bhatti, N.; Horsch, F. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi). Nov 1983. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86700187.

Gamma rays in the range from 60 keV to 730 keV have been observed following the spontaneous fission of ^{252}Cf, with high resolution Ge(Li) detector, full width at half maximum (FWHM) of 700 eV at 122 keV, in coincidence with the two fission fragments observed with surface barrier detectors. A total number of 18, 636, 549 events were recorded over a run period of about 150 hours stretching over three weeks. The events were sorted to generate gamma ray spectra belonging to 2 amu intervals gamma of the fragment masses and 6 MeV intervals of the total kinetic energy released. Some of the prominent gamma lines belonging to various masses of the fission fragments have been identified. For some gamma lines, the intensities have been evaluated as a function of the total kinetic energy of the fission fragments.

8028 **Search for superheavy elements using the ^{48}Ca+^{254}Es/sup g/ reaction.** Lougheed, R.W.; Landrum, J.H.; Hulet, E.K.; Wild, J.F.; Dougan, R.J.; Dougan, A.D.; Gaeggeler, H.; Schaedel, M.; Moody, K.J.; Gregorich, K.E. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] C: Nuclear Physics;* **32**: No. 5, 1760-1763(Nov 1985). Contract W-7405-ENG-48.

We measured upper limits for the production of superheavy elements from the compound nucleus reaction ^{48}Ca+^{254}Es. This combination permits the closest approach to the predicted island of stability at the 184 closed-neutron shell of any practical fusion reaction. We used aqueous and gas-phase separations to isolate superheavy element fractions within an hour from the end of the bombardments. In these experiments we did not observe superheavy elements above a limit of 3 x 10^{-31} cm^2 for spontaneous-fission half-lives from fractions of a day to a few months.

8029 **Linear momentum transfer in 40—150 MeV proton-induced reactions with ^{238}U.** Fatyga, M.; Kwiatkowski, K.; Karwowski, H.J.; Woo, L.W.; Viola, V.E. (Departments of Physics and Chemistry and Indiana University Cyclotron Facility, Indiana University, Bloomington, Indiana 47405). *Physical Review [Section] C: Nuclear Physics;* **32**: No. 5, 1496-1505(Nov 1985).

Angular correlations between coincident fission fragments have been measured for 40-, 90-, and 150-MeV proton-induced reactions on a ^{238}U target. From these data linear momentum transfer distributions have been derived, which are then compared with other results for protons and more complex projectiles. On a per nucleon basis, protons exhibit the largest average linear momentum transfer values of any projectile over the energy range from E/A = 40 to 1000 MeV. This can be understood in terms of fundamental scattering cross sections, and is qualitatively demonstrated by intranuclear cascade calculations. Both cascade and precompound decay calculations reproduce the linear momentum transfer distributions with moderate success.

6530 NUCLEAR THEORY

8030 **(BNL—37196) HIJET: a Monte Carlo event generator for P-nucleus-nucleus collisions.** Ludlam, T.; Pfoh, A.; Shor, A. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 9p. (CONF-8504152—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002924.

From Workshop on experiments for Relativistic Heavy Ion Collider (RHIC); Upton, NY, USA (15 Apr 1985).

Comparisons are shown for the HIJET generated data and measured data for average multiplicities, rapidity distributions, and leading proton spectra in proton-nucleus and heavy ion reactions. The algorithm for the generator is one of an incident particle on a target of uniformly distributed nucleons. The dynamics of the interaction limit secondary interactions in that only the leading baryon may re-interact with the nuclear volume. Energy and four momentum are globally conserved in each event. 6 refs., 6 figs. (WRF)

8031 **(CONF-850942—34) Boson fermion symmetries and dynamical supersymmetries for odd-odd nuclei.** Balantekin, A.B.; Huebsch, T.; Paar, V. (Oak Ridge National Lab., TN (USA); Maryland Univ., College Park (USA); Zagreb Univ. (Yugoslavia). Prirodoslovno Matematicki Fakultet). 1985. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002196.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

Odd-odd nuclei are modeled by the application of symmetries and supersymmetries in IBM/IBFM. Odd-odd nuclei are described as a mixed system if bosons and fermions by a Hamiltonian consisting of three contributions: the IBM Hamiltonian, a one-fermion and fermion-fermion interaction terms, and a boson-fermion interaction term. 23 refs., 2 figs., (WRF)

8032 **(CONF-851157—1) Optical models in the resolved resonance region.** Johnson, C.H. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003305.

From Specialists' meeting on the use of the optical model for the calculation of neutron cross sections below 20 MeV; Paris, France (13 Nov 1985).

Using modern time-of-flight facilities the resolved region can be extended upward to about 1 MeV for nuclei with $A < 60$ and for heavier nuclei near closed shells. A careful measurement both on and off resonances followed by an R-matrix analysis yields partial wave scattering functions which are easily energy averaged for comparison to those from an optical model. A comparison of average scattering functions of opposite parities can provide information on surface effects because the wave functions for different parities are out of phase at the surface. Thus, a unique supplement is made to the information that can be obtained from other types of measurements for both the bound region and higher energies. 16 refs., 9 figs., 1 tab.

8033 **(DOE/ER/02696—31) Neutron cross section measurements using the ORELA: ^{60}Ni(n,x), ^{40}Ca(n,x), ^{22}Ne(n,γ), ^{189}Os(n,n'), /sup 186,187,188,189/Os(n,x), ^{189}Os(n,γ), /sup 148,149,150/Sm(n,γ), ^{179}Ta(n,γ), /sup 86,87,88/Sr(n,x), ^{40}Ar(n,x), the stable tellurium isotopes (n,γ) and ^{205}Tl(n,x). Progress report, September 1, 1984-August 31, 1985.** Winters, R.R. (Denison Univ., Granville, OH (USA). Dept. of Physics). Aug 1985. Contract AC02-76ER02696. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86002813.

The research performed during this reporting period (9/1/84 to 8/31/85) resulted in: (1) publication of three papers; (2) presentation of an invited paper to the conference on "Neutron-Nucleus Collisions: A Probe of Nuclear Structure"; (3) presentation of three contributed papers at APS meetings; and (4) preparation of three manuscripts, two of which are in the process of internal review at the Oak Ridge National Laboratory and are included with this report, and the third is being typed as this report is being written. The publications and papers deal with topics in both nuclear structure and astrophysics. Our efforts to study the systematic behavior of the optical model potential in the energy region just above neutron binding has been made substantially more reliable with the publication of a paper which discusses the accuracy of the methods used to average the measured scattering matrix. In the area of stellar nucleosynthesis, comparison of our model calculations and measured cross sections of ^{189}Os(n,n') and ^{189}Os(n,γ) give confidence that the effect of capture from the first excited state of ^{187}Os on the s-process can now be accurately calculated. 18 refs., 12 figs., 5 tabs.

8034 **(INIS-mf—9947, pp 8) Computer codes for nuclear reaction cross sections.** Uhl, M. (Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Radiumforschung und Kernphysik). 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85702930.

Published in summary form only.
In Progress report 1984.

8035 **(SLAC-PUB—3787) Multiquark evolution in QCD.** Ji, C.R. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Stanford Univ., CA (USA)). Sep 1985. Contract AC03-76SF00515. 8p. (CONF-8508127—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002941.

From Nuclear chromodynamics conference; Santa Barbara, CA, USA (12 Aug 1985).

We present a formalism for the evolution in Q_3 of multiquark systems as an application of perturbative quantum chromodynamics (QCD) to asymptotic, exclusive nuclear amplitudes. To leading terms in log Q^2 our formalism is equivalent to solving the renormalization group equations for these amplitudes. Completely antisymmetric multiquark color-singlet represntations are constructed and their evolution is investigated from the one-gluon exchange kernel. We argue that the evolution equation, together with a cluster decomposition, demonstrates a transition from the traditional meson and nucleon degrees of freedom of nuclear physics to quark and gluon degrees of freedom with increasing Q^2, or at small internucleon separation. As an example, we derive an evolution equation for a completely antisymmetric six-quark distribution amplitude and solve the evolution equation for a deuteron S-wave amplitude. The leading anomalous dimension and the corresponding eigensolution are found for the deuteron in order to predict the asymptotic form of the deuteron distribution amplitude (i.e., light-cone wave function at short distances). The fact that the six-quark state is 80 percent hidden color at small transverse separation implies that the deuteron form factor cannot be described at large Q^2 by meson-nucleon degrees of freedom alone. Furthermore, since the N-N channel is very suppressed under these conditions, the effective nucleon-nucleon potential is naturally repulsive at short distances. 20 refs.

8036 **Delta excitations in heavy nuclei induced by (^{3}He,t) and (p,n) reactions.** Esbensen, H.; Lee, T.H. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 6, 1966-1971(Dec 1985). Contract W-31-109-ENG-38.

Delta excitations in heavy nuclei, induced by charge exchange reactions, are studied using the surface response model. The residual pion-exchange interaction and the self-energy of the delta in a nuclear medium is included in the random-phase-approximation response. The peak position observed in (^{3}He,t) reactions can be explained by the self-energy of the delta extracted from pion-nucleus scattering, and the magnitude of the cross section is consistent with Glauber theory. The comparison to (p,n) data is reasonable; contributions from neutron decay of the delta, which are left out in the calculations, constitute a substantial experimental background.

8037 **Continuum spectra for 165 MeV pion-nucleus single charge exchange.** Klein, A.; Siciliano, E.R.; Auerbach, N. (Department of Physics and Astronomy, University of Georgia, Athens, Georgia 30602). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 6, 1998-2005(Dec 1985).

Continuum spectra for pion single charge-exchange scattering at 165 MeV kinetic energy are calculated for a number of nuclei within the single-scattering approximation over a wide range of nuclear excitation energy. The discrepancy between our calculations and the data suggests that multiple-scattering processes may contribute significantly to the charge-exchange spectra. This suggestion is consistent with the present understanding of the delta-nucleus interaction as given, for example, by the isobar-hole model.

8038 **Absorption cross sections and the use of complex potentials in coupled-channels models.** Satchler, G.R. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 6, 2203-2204(Dec 1985).

We give a simple and transparent derivation of a result obtained recently by Kim, Udagawa, and Tamura for the loss of flux occurring in the coupled-channels scattering problem when a complex potential is used. The loss of flux, or absorption cross section, consists of three components: absorption from the elastic channel, absorption from the nonelastic channels, and absorption occurring during the elastic-nonelastic transitions. Some discussion is given of these results and their application to fusion reactions.

8039 **Mixed-symmetry interpretation of some low-lying bands in deformed nuclei.** Scholten, O.; Heyde, K.; Van Isacker, P.; Otsuka, T. (National Superconducting Cyclotron Laboratory and Department of Physics and Astronomy, Michigan State University, East Lansing, Michigan 48824). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 5, 1729-1734(Nov 1985).

An alternative interpretation of the second excited K/sup π/ = 0^+ band in rare earth nuclei, as a mixed-symmetry state in the neutron-proton interacting boson model, is compared with the conventional interpretation as a two-quasiparticle band. It is shown that, on the basis of electromagnetic decay probabilities and particle transfer amplitudes alone, it is difficult to discriminate between the two interpretations. Only on the level of form factors and transition densities do major differences occur.

8040 **F-spin multiplets of nuclei and their relation to U(12).** Frank, A.; Van Isacker, P. (Centro de Estudios Nucleares, Universdad Nacional Autonoma de Mexico, Delg. Coyoacan 04510 Mexico, Distrito Federal, Mexico). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 5, 1770-1772(Nov 1985).

We show that the existence of F-spin multiplets of nuclei can be understood in terms of an embedding into U(12). With this alternative view of F-spin multiplets some of their properties are clearly established.

8041 **Statistical properties of parameters of the scattering matrix for compound nuclear reactions.** Dagdeviren, N.R.; Kerman, A.K. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Annals of Physics (New York);* **163**: No. 1, 199-211(Aug 1985). Contract AC02-76ER03069.

A numerical calculation for determining the statistical distributions of the partial level widths and S-matrix poles is performed. Many of the expected properties of these distributions are confirmed. It is found that the parameters of the optical background representation have more suitable statistical properties. A new relationship among the parameters of the optical background representation, with its numerical checks, is presented.

6540 RADIATION AND SHIELDING PHYSICS

REFER ALSO TO CITATION(S) 7204

8042 **(CONF-8410112—4) Scattering from correlations in colloidal systems.** Hayter, J.B. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002206.

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

Colloidal suspensions typically exhibit spatial correlations over distances of order $10\text{-}10^4$ A, corresponding either to the size of individual particles (e.g., polymer chains, surfactant micelles) or to the range of interaction between particles (e.g., charged polymer lattices at low ionic strength). Apart from having fundamental intrinsic interest, such systems are also extremely useful as model systems with which to study, for example, non-Newtonian hydrodynamics, since temporal correlations are generally much longer lived (10^{-9}-10^{-3} sec) than those found in simple atomic or small molecular systems (10^{-13}-10^{-10} sec). Colloids have long been the subject of macroscopic phenomenological research (on rheological properties, for example), but it is only recently that microscopic light, x-ray and neutron scattering techniques have been applied to their study, in large part because of theoretical difficulties in understanding the scattering from dense liquid-like systems of interacting particles. For spherical colloids, such theoretical problems have now been largely overcome, and for anisotropic colloids experimental techniques are being developed which circumvent the intractable theoretical areas. This paper will first review some static light and small-angle neutron scattering (SANS) results on colloidal suspensions, both at equilibrium and in steady-state non-equilibrium situations, and will then discuss some dynamic measurements on polymer solutions and melts made using the neutron spin-echo (NSE) technique. Emphasis is placed on experiments which have a possible counterpart in synchrotron radiation studies. In particular, NSE extends the results of photon correlation spectroscopy (PCS) to larger momentum transfers and shorter time-scales than are available with visible light, and the extension of PCS to short wavelength on a synchrotron source would be of similar fundamental interest.

8043 **(CONF-8410256—2) Polarized neutrons and their applications.** Moon, R.; Endoh, Y.; Felcher, G.; Majkrzak, C.; Mezei, F.; Pynn, R.; Shirane, G. (Oak Ridge National Lab., TN (USA)). Jan 1985. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002269.

From Workshop on scientific opportunities with advanced facilities for neutron scattering; Shelter Island, NY, USA (23 Oct 1984).

The role of polarized neutrons in the study of magnetic and nonmagnetic materials is discussed. magnetic structure, spin density, nuclear magnetism and spin dynamics are listed as magnetic properties which may be accessed by polarized neutrons. Low dimensional magnets, disordered magnetic systems, surface magnetism are discussed as well as topography and depolarization. Polarization techniques are discussed for both study state and pulsed modes. 4 refs. (WRF)

8044 **(HEDL—7559) Nuclear research emulsion neutron spectrometry at the Little-Boy replica.** Gold, R.; Roberts, J.H.; Preston, C.C. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1985. Contract AC06-76FF02170. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003267.

Nuclear research emulsions (NRE) have been used to characterize the neutron spectrum emitted by the Little-Boy replica. NRE were irradiated at the Little-Boy surface as well as approximately 2 m from the center of the Little-Boy replica using polar angles of 0°, 30°, 60° and 90°. For the NRE exposed at 2 m, neutron background was determined using shadow shields of borated polyethylene. Emulsion scanning to date has concentrated exclusively on the 2-m, 0° and 2-m, 90° locations. Approximately 5000 proton-recoil tracks have been measured in NRE irradiated at each of these locations. Neutron spectra obtained from these NRE proton-recoil spectra are compared with both liquid scintillator neutron spectrometry and Monte Carlo calculations. NRE and liquid scintillator neutron spectra generally agree within experimental uncertainties at the 2-m, 90° location. However, at the 2-m, 0° location, the neutron spectra derived from these two independent experimental methods differ significantly. NRE spectra and Monte Carlo calculations exhibit general agreement with regard to both intensity as well as energy dependence. Better agreement is attained between theory and experiment at the 2-m, 90° location, where the neutron intensity is considerably higher. 14 refs., 18 figs., 11 tabs.

8045 **Energy-dependence of inner potential in Fe from low-energy electron absorption (target current).** Tamura, E.; Feder, R.; Krewer, J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung); Kirby, R.E.; Kisker, E.; Garwin, E.L.; King, F.K. (Stanford Linear Accelerator Center, CA (USA)). *Solid State Communications;* **55**: No. 6, 543-547(Aug 1985).

For unpolarized low-energy electrons (0-60 eV) incident on a Fe(001) surface, the measured current I absorbed by the crystal (target current) displays a considerable amount of fine structure depending on the angle of incidence. Dynamical calculations of the elastic reflection coefficient Rsub(e) show that - d^2Rsub(e)/dE^2 is in good agreement with d^2I/dE^2 for suitably chosen real and imaginary parts of the inner potential. The energy dependence of the

latter is thereby determined. Comparison with a bulk band structure calculated using the same real potential reveals a correspondence between target current minima and band gaps as well as current maxima and critical points.

6550 MEDICAL PHYSICS

8046 **(BFR-R—90-1984) Radon in housing. Construction measures in building and in reconstruction.** Clavensjoe, B.; Kumlin, H. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 88p. (In Swedish). (BFR—810559-8). NTIS (US Sales Only), PC A05/MF A01. File Number DE86700227.

Sources of radon in housing are recapitulated, and measures to minimize the effect of radioactive radon on the inhabitants are outlined. Practical solutions to specific construction problems for keeping radon from the ground and also from building materials at tolerable levels are given, in most cases as drawings.

8047 **(EUR—9290) Radiation protection of the public in respect of consumer goods containing radioactive substances.** (Commission of the European Communities, Luxembourg). 1984. 31p. (In French). Commission of the European Communities, Luxembourg.

Also published in English and German.

The use of consumer goods containing radioactive substances makes a contribution to the total exposure to ionizing radiation to which mankind is subjected. This publication, which has been worked out by the Commission with the aid of a group of experts in radiation protection, represents a practical guide for the health authorities of the Member States who are responsible for authorising the production, marketing and use of consumer goods containing radioactive substances. It contains detailed information in connection with the provisions of Articles 3, 4 and 5 of the Council Directive of 15 July 1980 amending the directives laying down the basic safety standards for the health protection of the general public and workers against the dangers of ionizing radiation, which provide for derogations from the general system of prior authorization. In addition, the document contains general criteria for control and authorization and describes a testing programme and its methods.

6560 SOLID-STATE PHYSICS

REFER ALSO TO CITATION(S) 7428, 7429, 7920

8048 **(DOE/ER/45132—3) Dynamics of fluid surfaces and the crystal-melt interface. Annual progress report, September 1, 1984-August 31, 1985.** Cummins, H.Z. (City Coll., New York (USA). Dept. of Physics). 1985. Contract FG02-84ER45132. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003830.

Research is described on the melting transition, dynamics of fluid surfaces, dynamics at nonequilibrium crystal-melt interface, and morphological instabilities and dendritic crystal growth. (GHT)

8049 **(LA-UR—85-3569) Mossbauer effect studies at pressures to 300 kbar.** Taylor, R.D. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 3p. (CONF-8505211—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002402.

From Raymond and Beverly Sackler distinguished lectures; Tel Aviv, Israel (5 May 1985).

In a recent experiment carried out at Los Alamos National Laboratory in collaboration with Prof. Moshe Paz Pasternak of Tel Aviv University, we have used the diamond anvil cell for a Mossbauer effect absorber experiment. A high-atomic-weight gasket material was developed; it served both to contain the pressure and to collimate the 27.8-keV Mossbauer effect gamma rays and nearby K x-rays emitted from the source. Elemental iodine is known to transform with pressure becoming metallic near 160 kbar. Furthermore, it has been reported that I_2 becomes monatomic at about 215 kbar. The Mossbauer effect of iodine-129 was employed to check this latter supposition. The Mossbauer effect "fingerprint" of I_2 was found to change slowly with pressure up to about 160 kbar whereupon a new high pressure phase or site began to appear. At 300 kbar the Mossbauer spectrum shows about half of the low temperature phase (I_2) is still present. This contradiction with x-ray results and or their interpretation is still under investigation.

8050 **(LBL—20354) Fourier transform zero field NMR and NQR.** Zax, D.B. (Lawrence Berkeley Lab., CA (USA)). Sep 1984. Contract AC03-76SF00098. 226p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86004008.

The characterization of the structural and chemical properties of matter, particularly in disordered condensed phases, is a difficult process. Few analytical methods work effectively on polycrystalline or amorphous solids. In many systems the chemical shifts measured by traditional high resolution solid state NMR methods are insufficiently sensitive or the information contained in the dipole-dipole couplings is more important. In these cases Fourier transform zero field magnetic resonance may make an important contribution. Zero field NMR and NQR is the subjecti of this thesis.

8051 **(SAND—85-1636C) Conduction band energy levels in superlattices with complex unit cells.** Osbourn, G.C. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 10p. (CONF-851217—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003715.

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

The conduction band energy levels and wavefunctions in a number of superlattices with more than two layers per unit cell have been calculated using an effective mass model. Many of these structures exhibit energy levels which can be modeled as resulting from a conventional superlattice with a modified bulk conduction band minimum in the effective wells. These structures should be useful for extending the size of the superlattice periods in strained-layer superlattices.

8052 **(UCRL—53686) Pseudopotential calculations and photothermal lensing measurements of two-photon absorption in solids.** White, W.T. III. (Lawrence Livermore National Lab., CA (USA)). 4 Nov 1985. Contract W-7405-ENG-48. 259p. NTIS, PC A12/MF A01; GPO Dep. File Number DE86004184.

Thesis. Submitted to Univ. of California, Davis.

We have studied two-photon absorption in solids theoretically and experimentally. We have shown that it is possible to use accurate band structure techniques to compute two-photon absorption spectra within 15% of measured values in a wide band-gap material, ZnS. The empirical pseudopotential technique that we used is significantly more accurate than previous models of two-photon absorption in zinc blende materials, including present tunneling theories (which are essentially parabolic-band results in disguise) and the nonparabolic-band formalism of Pidgeon et al. and Weiler. The agreement between our predictions and previous measurements allowed us to use ZnS as a reference material in order to validate a technique for measuring two-photon absorption that was previously untried in solids, pulsed dual-beam thermal lensing. With the validated technique, we examined nonlinear absorption in one other crystal (rutile) and in several glasses, including silicates, borosilicates, and one phosphate glass. Initially, we believed that the absorption edges of all the materials were comparable; however, subsequent evidence suggested that the effective band-gap energies of the glasses were above the energy of two photons in our measurement. Therefore, we attribute the nonlinear absorption that we observed in glasses to impurities or defects. The measured nonlinear absorption coefficients were of the order of a few cm/TW in the glasses and of the order of 10 cm/GW in the crystals, four orders of magnitude higher than in glasses. 292 refs.

8053 **Application of sum rules to the response of small metal particles.** Bertsch, G.; Ekardt, W. (Physics Department, University of Tennessee, Knoxville, Tennessee 37996 and Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* 32: No. 12, 7659-7663(15 Dec 1985). Contract AC05-84OR21400.

Sum rules for the response of small spherical systems are derived and compared to the response calculated in the time-dependent local-density approximation by Ekardt. The ω^3 sum rule, which can be expressed in closed form, is useful as a supplement to the polarizability sum in locating the plasmon. Explicit formulas are obtained for the shifts in the plasmon frequency resulting from the diffusivity of the charge density and from the potential field of the ground state. We show on quite general grounds that the plasmon in a jellium model is red-shifted from the Mie frequency.

8054 **Localization in two- and three-dimensional systems away from the band center.** Zdetsis, A.D.; Soukoulis, C.M.; Economou, E.N.; Grest, G.S. (Department of Physics and Research Center of Crete, University of Crete, Heraklio, Crete, Greece). *Physical Review [Section] B: Condensed Matter;* 32: No. 12, 7811-7816(15 Dec 1985). Contract W-7405-ENG-82.

Extensive numerical results using finite-size-scaling methods for two-dimensional (2D) and three-dimensional (3D) disordered systems are presented for eigenenergies E different from zero. Single-parameter scaling law is satisfied for all of our results in both 2D and 3D systems. In 2D we find only localized states, however, the localization length does not have its maximum at the band center. In 3D, the dependence of the mobility edge on the strength of the diagonal order is obtained. These results are found to be in satisfactory agreement with the predictions of the coherent-potential approximation and the potential-well analogy.

8055 **Negative differential conductivity in shallow-impurity hopping.** Emin, D.; Hart, C.F. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter;* 32: No. 10, 6503-6509(15 Nov 1985).

Charge carriers in shallow-impurity states in semiconductors are weakly coupled to the phonons. As such, hopping impurity conduction proceeds via a succession of jumps in which a single phonon is either emitted or absorbed. Hops can only occur between states which differ in energy by less than the energy of the maximum energy phonon which can be emitted or absorbed. With the application of a large electric field, hops nearly parallel to the direction of the applied electric field are precluded since their attendant energy difference is too great. As a result, at high electric fields energetically allowed hops are nearly perpendicular to the applied field. This results in a drift velocity which falls with electric field strength at large electric fields. The criterion for being in this "high-field" regime is that the electric-field-induced drop in potential energy between a typical pair of sites be greater than the energy of the highest-energy phonon with which the carrier interacts appreciably. For a large-radius impurity state the maximum energy acoustic phonon with which the impurity state interacts is a very small fraction of the Debye energy. With a large-radius impurity concentration of 10^{15} cm^{-3} in highly compensated Ge, high-field behavior is expected to occur for internal electric fields above 2.4×10^3 V/cm.

8056 **Clear evidence of redundant operators in Monte Carlo studies of the Ising model.** Shankar, R.; Gupta, R. (J. W. Gibbs Laboratory of Physics, Yale University, New Haven, Connecticut 06520). *Physical Review [Section] B: Condensed Matter;* 32: No. 9, 6084-6086(1 Nov 1985).

After reviewing the notion of redundant operators and the procedure for deriving them analytically for Ising systems, we present Monte Carlo renormalization-group data that clearly show their occurrence as eigenoperators in d = 2.

8057 **Spin-lattice relaxation in fractal systems.** Liu, S.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* 32: No. 9, 6094-6096(1 Nov 1985). Contract AC05-84OR21400.

Stapleton and co-workers have measured the spin-lattice relaxation rates of a number of protein molecules and interpreted the results in terms of the fractal nature of these complex systems. We examine the theoretical foundation of their work by calculating in detail the normal modes, local strain, and the temperature dependence of the Raman spin-lattice relaxation rate $1/T_1$ of an exactly soluble model system, the elastic Sierpinski gasket. No simple power-law dependence of $1/T_1$ on temperature is found in the entire temperature range.

6561 SUPERCONDUCTIVITY

REFER ALSO TO CITATION(S) 7434, 7441, 7484

8058 **Magnetic response of type-II superconductors subjected to large-amplitude parallel magnetic fields varying in both magnitude and direction.** Perez-Gonzalez, A.; Clem, J.R. (Ames Laboratory-USDOE and Department of Physics, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* 58: No. 11, 4326-4335(1 Dec 1985). Contract W-7405-ENG-82.

Starting from our general critical-state theory, which includes the effects of both flux-line cutting and flux pinning, we develop a numerical method for finding the magnetic response of type-II superconductors subjected to parallel magnetic fields that change in both magnitude and orientation. We describe model calculations of the time-evolving magnetic profiles when the direction of an applied magnetic field of fixed magnitude oscillates with large amplitude, and we compare our results with related experiments by Cave and LeBlanc. We also report model calculations for the ac behavior when the sample is subjected to a dc bias field and a large-amplitude ac field at various angles (0°, 45°, and 90°) relative to this field.

6570 THEORETICAL PHYSICS

REFER ALSO TO CITATION(S) 8052

8059 **(LA-UR—85-3212) Quantized field formulation of the free-electron laser in the Heisenberg picture.** Takeda, H. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 15p. (CONF-850956—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002392.

From 7. international free-electron laser conference; Tahoe City, CA, USA (8 Sep 1985).

The phase and amplitude operator equations valid for field intensities ranging from a single photon state to an intense laser state are derived by means of quantized field theory. Using the Dirac equation, driving current operators, which are expressed by radiation and electron fields, are separated into spontaneous, stimulated, and spin terms. Then, utilizing the semiclassical nature of the electron state, coherence condition and spectral equations are derived. From the spectral phase equation, a delay-time scaling for oscillator operation is obtained in good agreement with experiments. 1 ref.

8060 **(LA-UR—85-3546) Diamond anvil cells: a new tool for high pressure studies.** Taylor, R.D. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-8505211—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002384.

From Raymond and Beverly Sackler distinguished lectures; Tel Aviv, Israel (5 May 1985).

Literally hundreds of papers have appeared in the last few years covering a myriad of uses of the diamond anvil cells. The crescendo shows no signs of abating. Static pressures as high as 1.8 megabar have been reported. Still higher pressures appear possible. Measurements have been made at dilution refrigerator temperatures (less than 50 millikelvins) and to temperatures over 1000 C in spe-

cial sample ovens. Obviously these methods cannot be applied to every physics problem, but the limitations of the DAC are being challenged daily.

8061 **(LBL—20089) Quantum chemistry by quantum Monte Carlo: beyond ground-state energy calculations.** Reynolds, P.J.; Barnett, R.N.; Hammond, B.L.; Grimes, R.; Lester, W.A. Jr. (Lawrence Berkeley Lab., CA (USA)). Aug 1985. Contract AC03-76SF00098. 17p. (CONF-850859—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003993.

From 5. international congress on quantum chemistry; Montreal, Canada (19 Aug 1985).

We present recent advances with the quantum Monte Carlo (QMC) method in its application to molecular systems. The QMC method is a procedure for solving the Schroedinger equation statistically, by the simulation of an appropriate random process. The formal similarity of the Schroedinger equation with a diffusion equation allows one to calculate quantum mechanical expectation values as Monte Carlo averages over an ensemble of random walks. We have previously obtained highly accurate correlation energies for a number of molecules, as well as the singlet-triplet splitting in methylene and the barrier height for the H + H_2 exchange reaction. Recently we have begun a program of extending the QMC approach to the calculation of analytic derivatives of the energy. A brief description of the approach is presented here, together with some preliminary results. In addition, we are now computing expectation values of properties other than the energy. We summarize how standard QMC must be modified, and present some results for H_2 and N_2. Finally, we describe preliminary work toward the goal of obtaining accurate molecular excited states through QMC. 24 refs., 5 tabs.

8062 **Tree graphs and the solution to the Hamilton—Jacobi equation.** Molzahn, F.H.; Osborn, T.A. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742 and Department of Physics, University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada). *Journal of Mathematical Physics (New York);* **27**: No. 1, 88-99(Jan 1986).

A combinatorial method is used to construct solutions of the Hamilton—Jacobi equation. An exact expression for Hamilton's principal function S is obtained for classical systems of finitely many particles interacting via a certain class of time-dependent potentials. If x, p, and t are the position, momentum, and time variables for N point particles of mass m, it is shown that Hamiltonians of the form $H(x,p,t) = (1/2m)p^2+v(x,t)$ have complete integrals S that are analytic functions of the inverse mass parameter m^{-1} in a punctured disk about the origin. If v(x,t) is bounded, C/sup infinity/ in the x variable, and has controlled x-derivative growth, then the coefficients of the Laurent expansion of S about $m^{-1} = 0$ may be expressed in terms of gradient structures associated with tree graphs. This series expansion for $S(x,t; y,t_0)$ converges absolutely, and uniformly for all x, y for time displacements $'t-t_0' <$ Tequivalent$2K^{-1}(m/eU)^{1}$/sup //^{2}, where K and U are bounds associated with the space derivatives of the potential.

8063 **Theory of one-parameter subgroups of supergroups.** Truax, D.R.; Kostelecky, V.A.; Nieto, M.M. (Theoretical Division and Center For Nonlinear Studies, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Journal of Mathematical Physics (New York);* **27**: No. 1, 354-364(Jan 1986).

The one-parameter subgroups of supergroups are defined and their primary properties are delineated. Parametrization schemes analogous to those used in Lie group theory are investigated. In particular, exponentiation is introduced and related to the one-parameter subgroups. Canonical coordinates of three kinds are investigated, the third of which has no analog in conventional Lie theory. We illustrate our results with the examples of the supersymmetric quantum-mechanical superalgebra sqm(2) and the simple superalgebra osp(1/2).

8064 **Approximate treatment near resonance of backward and traveling wave tubes in the Compton regime.** Swegle, J.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physics of Fluids;* **28**: No. 12, 3696-3702(Dec 1985). Contract AC04-76DP00789.

Backward and traveling wave tubes are devices in which the kinetic energy of an electron beam is converted into electromagnetic radiation through interaction with a slow wave structure. In the low-current, or Compton, regime of operation, the linear instability leading to microwave generation is the result of a three-wave process involving the two space-charge waves on the beam and a normal mode of the slow wave structure. The three-wave character of this resonance is explored qualitatively and quantitatively by deriving an approximate, cubic dispersion relation valid near the resonance. Although the approximate dispersion relation is derived from the full relation for a specific system, the method of analysis is quite general and can easily be applied to other configurations. The approximate dispersion relation is employed to find expressions for the growth rates in these devices, to place this electromagnetic analysis into correspondence with Pierce's circuit analysis, and to arrive at a proof that the instability in the backward wave device is absolute, while that in the traveling wave tube is convective.

8065 **Supersymmetry and the relationship between the Coulomb and oscillator problems in arbitrary dimensions.** Alan Kostelecky, V.; Martin Nieto, M.; Rodney Truax, D. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review [Section] D: Particles and Fields;* **32**: No. 10, 2627-2633(15 Nov 1985).

We construct the relationship between the radial equations of the d-dimensional hydrogen atom and the D-dimensional simple harmonic oscillator. The supersymmetric partners of each of these systems are obtained, and a series of maps between the various systems is delineated. We present an explicit physical example of our maps. Finally, we generalize to D dimensions the recent work of Balantekin on the supersymmetric oscillator with spin-orbit coupling, and we demonstrate that this supersymmetry is different from the one we study.

8066 **Functional measure in Kaluza-Klein theories.** Unz, R.K. (Department of Physics, Stanford University, Stanford, California 94305 and Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **32**: No. 10, 2539-2549(15 Nov 1985). Contract AC03-76SF00515.

The principal features of classical Kaluza-Klein theories for scalar, vector, and gravitational fields are reviewed and summarized. It is then argued that existing forms of the Kaluza-Klein Ansatz are potentially inconsistent on the quantum level due to functional-measure discrepancies. The canonical functional measures for integer-spin fields, derived elsewhere, are used to demonstrate the partial quantum consistency of toroidally compactified Kaluza-Klein theories of scalar, vector, and gravitational fields in an arbitrary number of dimensions. It is shown that the use of any of the other popular functional measures found in the literature would lead to the inconsistency of Kaluza-Klein compactifications. It is argued that the quantum consistency of field theories based on the canonical functional measure is an automatic consequence of the transformation properties of that measure under field redefinitions, with the full quantum consistency of all Kaluza-Klein theories following as a special case of this general rule. Finally it is suggested that nontrivial measure factors may act to stabilize the Kaluza-Klein Casimir effect.

8067 **Some practical aspects of moving object deblurring in a perspective plane.** Ghiglia, D.C.; Jakowatz, C.V. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Optics;* **24**: No. 22, 3830-3837(15 Nov 1985). Contract AC04-76DP00789.

An image restoration problem commonly encountered in many branches of science and engineering is that of removing the effects of uniform object motion. If the direction of object motion is not orthogonal to the line of sight of the imaging device, an image with both nonuniform motion blur and perspective may be

produced so that the usual assumption of a space-invariant linear operation is no longer valid. In this paper we show that a proper initial geometrical transformation reduces the problem to one which can be handled by standard methods for removing uniform motion blur. As will be demonstrated, the process is strictly valid for planar (2-D) objects only. For objects with depth, residual space-variant blurs still exist. We highlight through examples several practical aspects of digitally deblurring such objects, including proper geometrical transformations, initial blur estimation, and residual space variance.

8068 **Nonlinear pulse propagation in the presence of evaporating aerosols.** Armstrong, R.L.; Gerstl, S.A.W.; Zardecki, A. (Department of Physics, Applied Laser Optics Group, New Mexico State University, Las Cruces, New Mexico 88003). *Journal of the Optical Society of America A: Optics and Image Science;* **2**: No. 10, 1739-1746(Oct 1985).

A set of coupled, nonlinear differential equations is developed describing the propagation of a pulsed, quasi-monochromatic beam of electromagnetic radiation in a medium containing vaporizing aerosols. Spatiotemporal distortions in the beam are produced as a result of radiation-induced changes in the absorption and scattering coefficients as well as in the angular spread of the phase function. The irradiance distribution function of the pulse is governed by a time-dependent transfer equation in the small-angle approximation. Numerical solutions to the equations are obtained for the case of pulse propagation through a cloud of vaporizing water droplets. It is found that significant spatiotemporal distortion of the pulse accompanies enhanced aerosol vaporization.

8069 **Field theories and growth models.** Parisi, G.; Yi-Cheng, Z. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Statistical Physics;* **41**: No. 1, 1-36(Oct 1985).

Continuum field theories for the Eden and DLA models are formulated, and they are shown to be related to the reggeon field theories with local and nonlocal interactions, respectively.

8070 **Comments on "Locality, Bell's theorem, and quantum mechanics".** Stapp, H.P. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Foundations of Physics;* **15**: No. 9, 973-976(Sep 1985). Contract AC03-76SF00098.

Two different ideas of locality are described. Both are due essentially to Einstein. Quantum theory is compatible with the first but not the second. The problems encountered in the article cited in the title arise from trying to use only the first idea of locality, whereas Bell's-theorem considerations pertain to the second.

6580 MATHEMATICAL PHYSICS

REFER ALSO TO CITATION(S) 7683, 7940, 8062, 8063

70 FUSION ENERGY

7001 PLASMA RESEARCH

REFER ALSO TO CITATION(S) 7784, 7911, 8127

8071 **(DOE/ET/51013—162) Lower hybrid heating experiments in tokamaks: an overview.** Porkolab, M. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Oct 1985. Contract AC02-78ET51013. 29p. (PFC/CP—85-9; CONF-8509192—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86003363.

From Course and workshop on applications of RF waves to tokamak devices; Varenna, Italy (5 Sep 1985).

Lower hybrid wave propagation theory relevant to heating fusion grade plasmas (tokamaks) is reviewed. A brief discussion of accessibility, absorption, and toroidal ray propagation is given. The main part of the paper reviews recent results in heating experiments on tokamaks. Both electron and ion heating regimes will be discussed. The prospects of heating to high temperatures in reactor grade plasmas will be evaluated.

8072 **(UCLA/PPG—875) Theory and modelling of helium enrichment in plasma experiments with pump limiters.** Prinja, A.K.; Conn, R.W. (California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering). 1984. Contract AS03-80ER52062. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003204.

Helium enrichment in the exhaust gas stream flowing from a hydrogen-helium plasma is studied using an analytical theory and Monte Carlo simulations. To provide a sensitive experimental test in a tokamak, an unusual configuration, inverted from traditional designs, is proposed for a pump limiter. The principle can be tested in other plasma devices as well. The theory suggests that for typical plasma edge conditions in a confinement device, namely, n = $10^{13}cm^{-3}$ and T/sub i/ = T/sub e/ ≅ 5-30eV, helium enrichment in the neutral gas exhaust stream can be very high, in the range 5 to 7, relative to the helium-hydrogen ratio in the plasma. Such high enrichment factors are achieved by exploiting the difference between the ionization rates of hydrogen and helium and the negligible helium charge exchange rate at these plasma conditions. A limiter arrangement is proposed in which the natural curvature of the toroidal magnetic field is used to isolate, using the plasma itself, the point of plasma neutralization from the location of the gas exhaust. The plasma region then acts to preferentially screen the recycling hydrogen by the processes of ionization and of charge-exchange-induced losses at open boundaries. The theory and analysis suggests that an experiment can provide a sensitive test of modules used to describe the plasma edge and of atomic and surface physics data used in these models.

8073 **(UCRL—92718) Time resolved neutron spectrum measurements at the Mirror Fusion Test Facility.** Slaughter, D. (Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 5p. (CONF-851009—19). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002857.

From IEEE nuclear science symposium; San Francisco, CA, USA (23 Oct 1985).

An advanced neutron diagnostic system has been developed for spectrum measurements on MFTF. Its collimated field of view allows spatially resolved neutron spectrum measurements. The 10 Mhz pulse height analysis and particle identification capability allow spectrum measurements in intervals as short as 10 ms. These capabilities will be used for space and time resolved determinations of ion energy from measurements of neutron Doppler width.

8074 **Density sensitive x-ray line ratios in the Be I, B I, and Ne I isoelectronic sequences.** Feldman, U.; Seely, J.F.; Bhatia, A.K. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, DC 20375-5000). *Journal of Applied Physics;* **58**: No. 11, 3954-3958(1 Dec 1985).

The intensities of x-ray transitions in highly charged ions in the Be I, B I, and Ne I isoelectronic sequences have been calculated as functions of electron density. The intensities of the transitions from the 2s/sup n/ 2p/sup m/ 3p configuration, relative to the intensities from the 2s/sup n/ 2p/sup m/ 3s and 2s/sup n/ p/sup m/ 3d configurations, are strong functions of electron density in high-density plasmas. The density sensitivity occurs at electron densities between 10^{16} cm^{-3} (for Si ions) and 10^{22} cm^{-3} (for Kr ions). Opacity is unimportant for plasma dimensions that are characteristic of dense laser-produced plasmas. These x-ray line ratios represent a promising new density diagnostic for high-density plasmas.

8075 **Photoemissive materials for 0.35 μm laser fiducials in x-ray streak cameras.** Hale, C.P.; Medecki, H.; Lee, P.H.Y. (Lawrence Livermore National Laboratory, Livermore, California 94550). *AIP (American Institute of Physics) Conference Proceedings;* **119**: No. 1, 193-198(1 Sep 1984). Contract W-7405-ENG-48.

Using a soft x-ray streak camera, materials are tested for suitability as transmission photocathodes when irradiated by 0.35 μm laser pulses. Preliminary measurements of sensitivity, dynamic range, and temporal resolution are reported. A practical fiber-optic fiducial under development for laser fusion x-ray diagnostics on the LLNL Nova laser system is described.

8076 **Space potential, electron temperature, and electron density measurements on rentor with a heavy ion beam probe.** Schoch, P.M.; Hickok, R.L.; Jennings, W.C. (Rensselaer Polytechnic Institute, Troy, NY). pp 139 of 1983 IEEE Interation Conference on Plasma Science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

The heavy ion beam probe on RENTOR has been used to measure radial profiles of the plasma space potential and total abundance signal from both Cs^{2+} and Cs^{3+} ions produced from a 20-30 keV Cs^{+} probing beam. The use of two ionization states provides two independent measures of the space potential, and allows the electron temperature and density to be calculated from the abundance signal.

8077 **Electron cyclotron resonance heating in phaedrus and TMX-U.** Lam, N.T.; Audenaerde, K.; Scharer, J. (University of Wisconsin). pp 94 of 1983 IEEE interation conference on plasma science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

We present a numerical analysis of electron cyclotron resonance heating (ECRH) at the first harmonic, in two tandem mirrors: Phaedrus and TMX-U. Our theoretical approach is as follows: Assume a separable electron distribution function f/sub o/ with a loss cone like character, i.e. f/sub o/ about p/sup 2l/ exp(-p^2/T not = p^2/T). with l = positive integer. Derive expressions for the elements of the dielectric tensor ϵ from the fully relativistic Vlasov equation. In the weekly relativistic limit (electron temperature < 50 keV), and dielectric tensor elements can be analytically expressed in terms of the Dnestrovskii functions. Trace out the path of electromagnetic energy in the geometrical optics approximation. Calculate the absorption coefficient α along the rays from the weak absorption formula utilized here.

8078 **Measurement of x-ray spectra during lower hybrid current drive experiments on the Alcator C Tokamak.** Texter, S.; Lloyd, B.; Porkolab, M.; Rice, J.; Schuss, J. (P.F.C., M.I.T., Cambridge, MA). pp 97-98 of 1983 IEEE interation conference on plasma science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

We report measurements of hard x-ray energy spectra in the range E $\geqq$ 30 keV obtained during lower hybrid current drive experiments on the Alcator C Tokamak. The spectra were measured using a 2" x 2" sodium iodide (NaI) scintillator encased in a lead shield with a narrow collimator, followed by a pulse height analysis system. The pulse gating system is such as to allow four separate spectra to be collected during a given plasma discharge, thereby giving some temporal information. Furthermore, the detector and the lead shielding assembly is movable to permit a spatial radial scan of the plasma on a shot-to-shot basis. To date, the x-ray data show a tail with photon energies extending out to about 300 keV during the time when 500 kW of RF power is injected into a plasma at a density of n $\leqq$ 5 x 10^{13} cm^{-3} and magnetic field B about 8 - 10T. Under these conditions, the RF power maintains a flat-top toroidal current of I $\cong$ 160 KA even when the ohmicheating current is shut off. Before the RF power is injected, a negligible amount of hard x-rays is generated. Hard x-rays in the energy range E$\geqq$ 30 keV are also absent from a discharge without RF power, but with plasma conditions similar to those of an RF current driven discharge. A one-dimensional numerical technique for determining the parallel electron energy distribution from the measured x-ray spectra, and some distributions generated using this technique, is presented. These experiments are continuing and a four detector array that will permit spatial resolution during a given discharge is being designed.

8079 **Some novel features of the ordinary mode electron cyclotron resonance heating of Tokamak Plasmas.** Arunasalam, V.; Efthimion, P.C.; Hosea, J.C.; Hsuan, H.; Taylor, G. (Princeton Univ., Plasma Physics Laboratory, Princeton, NJ). pp 95 of 1983 IEEE interation conference on plasma science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

In this paper we are primarily interested in discussing some of the novel and unique features of the ordinary (O) mode ECRH. We show that the finite k linear theory of O-mode absorption predicts: first, that the Doppler effect splits the two-fold degenerate k = O resonance into two closely spaced resonances instead of the usual Gaussian broadening; and second, that although the total absorption is due to the finite size of the electron Larmor orbits, it is mainly determined by T and is only weakly dependent on T via cyclotron overstability type terms. 'Here and refer to directions parallel and perpendicular, respectively, to the confining magnetic field. Finally, we examine some of the consequences of these unique O-mode absorption features on plasma heating, MHD behavior, and steady-state RF current drive in tokamaks.

8080 **THE 60 GHz transmission system for the Doublet III electron cyclotron heating experiment.** Moeller, C.P.; Lin, S.H.; Moeller, C.P.; Prater, R. (GA Technologies Inc., San Diego, CA). pp 93-94 of 1983 IEEE interation conference on plasma science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

The transmission and launching scheme being used for the ECH experiments at 60 GHz on the Doublet III tokamak and its behavior at low and high power is described. In this system design, the TE_{01} circular electric mode is used for transmission, with the waveguide diameter chosen as small as is consistent with acceptable ohmic loss in order to permit corrugated waveguide bends and mode converters to be of reasonable length, as well as to minimize unintentional mode conversion. Implementing this design requires that the 200 kW, TE_{02} mode output of the gyrotron in 2.5 in. diameter waveguide be tapered down (to 1.094 in.) and converted to the TE_{01} mode, which is accomplished by a taper and a rippled wall mode converter. There is a waveguide run of approximately 60 ft, which includes four 90° corrugated waveguide bends, as well as two directional couplers and a 30 kV DC break. A quartz window is used for the vacuum break at the tokamak vacuum vessel, after which the TE_{01} mode power is converted to the TE_{11} mode by a periodic curvature mode converter which is also the radiating element. Based on low power tests, the conversion efficiencies for the TE_{02} to TE_{01} converter and the TE_{01} to TE_{11} converter are 99% and 90%, respectively, while the TE_{01} transmission system (including 3 of the 4 bends) is 90% efficient. This latter measurement, which was swept over a 400 MHz band centered on the gyrotron output frequency, showed no ripples or dips. The overall efficiency into the TE_{11} mode is about 75% when the remaining components are included, with about 10% of that being ohmic loss.

8081 **Critical issues in radiation hardening of fusion diagnostic systems.** Baur, J.F.; Barker, R.A.; Engholm, B.A.; Miller, P.H. (GA Technologies Inc., San Diego, CA). pp 411 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

In the most recent phase of the DOE funded program in Radiation Hardening of Fusion Reactor Diagnostics, a study and listing have been completed of the critical issues. With this information a long range program plan-including system studies, data surveys and a sponsored experimental program-is being developed for integration into the DOE Fusion Engineering Development Plan. More than twenty critical issues were identified, ranked in terms of three parameters (priority, urgency and impact) and described in terms of the remaining research needed. In addition to the critical issues list, three studies that were completed to assess the impact of some of the critical issues are described here briefly. A Survey was

conducted of detectors and transducers expected to be impaired by doserate effects in the fusion environment. A set of Monte Carlo computer calculations of the streaming of neutrons through small, diagnostic-sized penetrations in a blanket-shield structure showed that simple analytic expressions for such streaming are inadequate for even preliminary designs of radiationsensitive diagnostic systems. Tests on radiation-darkened window blanks of quartz and sapphire showed that transmission in the ultraviolet region was improved by annealing at 300°C, indicating that it may be feasible to include windows in a well-designed viewing system in a reactor.

8082 **Control/interlock/display system for EBT-P using commercially-available hardware and firmware.** Schmitt, R.J. (McDonnell-Douglas Astronautics Co., St Louis, MO). pp 410 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

For the EBT-P project, alternative commercially-available hardware, software and firmware have been employed for control, interlock and data display functions. This paper describes the criteria and rationale used to select that commercial equipment and discusses the important features of the equipment chosen, especially programmable controllers. Additional discussion is centered on interface problems which are encountered upon attempts to integrate equipment from several vendors. Some solutions to these problems are discussed. Details of software and hardware performance during tests are presented. The extent to which the EBT-P hardware and software configuration addresses and resolves various issues is discussed. Several areas have been uncovered in which relatively slight improvements/modifications of commercial programmable controller firmware would significantly improve the capability of this type of hardware in fusion control applications. These improvements are discussed in detail.

8083 **CAMAC interfacing for TFTR control room graphics.** Ponton, W. (Princeton Plasma Physics Laboratory). pp 925-927 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The Tokamak Fusion Test Reactor (TFTR) control room displays a wide array of graphics. The variety of device types include: A Tektronix 4012 display multiplexer with capability to drive nine (9) Tektronix 613 storage tubes; a Grinnell GMR-27 graphics driver outputing color raster graphics to two (2) high resolution monitors; a PPPL Raster Graphics Generator 205 CAMAC module providing monochrome graphics & text; and a Tektronix 4006 storage tube display generator. It was determined early in the project's development to interface all graphics to one common CAMAC link. To accomodate all the devices on one link and utilize the maximum link speed, a certain amount of buffering at each driver interface seemed desirable. Although the system described in this study makes use of several different modules, the CAMAC command structure remains simple, essentially one write command and a read status command. On each module a LAM interrupt structure was provided that would generate a LAM upon going, empty or half empty. In conclusion, these modules provide greater flexibility in choosing which and how many devices to incorporate into the TFTR CAMAC graphics link.

8084 **Design of microprogrammed A/D CAMAC module.** Caldwell, G.S.; Patterson, D.M. (University of Texas, Fusion Research Center, Austin, Texas). pp 291-294 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The TAD1 a relatively low cost, single width CAMAC module capable of digitizing four analog signals at rates up to 100 kHz. The TAD1 is designed around a 16-bit AMD 29116 bipolar microprocessor controlled by an AMD 2910-1 microprogram controller and a 1K x 72-bit program memory. Data is stored locally in a 128K byte memory. The principal design goal of TAD1 is flexibility. This goal was met in a number of ways: 1) Since TAD1 is microprogrammed, it can be configured for different operating environments with relative ease. 2) The initial operating configuration allows flexible data taking with pre- and posttrigger, alternating time bases, and multiple trigger sources including relative trigger timing information. 3) TAD1 is interfaced to the Dataway in a manner which allows the contents of the 29116's 32register file to be examined transparently, thus allowing the Dataway to be a much more effective troubleshooting tool than is normally the case. 4) TAD1 can be easily modified to handle A/D's up to 16 bits. 5) Because it has a fast (7 million instructions per second) processor and a large (128K byte) local memory, TAD1's architecture could easily be the basis for a number of diverse functions (FFT processor for example).

8085 **Design and prototype results of a Far-Infrared Interferometer for MFTF-B.** Monjes, J.A.; Peebles, A.; Qin-Xin, Z.; Thomas, S.R.; Throop, A.L. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 281-286 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

A Far-Infrared (FIR) Laser Interferometer (FLI), operating at 185μm wavelength is planned as part of the initial start-up set of plasma diagnostics for the Mirror Fusion Test Facility. The FLI will consist of a heterodyne, three-chord laser interferometer which will be used initially to measure line-integrated plasma density in the high-density, center cell region of the machine. The conceptual system design and analysis has been completed. There are several unique environmental/ physical constraints and performance requirements for this system which have required that technology-evaluation and prototyping experiments be completed to support the design effort and confirm the expected performance parameters. Issues which have been addressed include extensive use of long-path dielectric waveguide, coupling and control of free-space propagation of the beam, and polarization control. The results and conclusions of the design analysis and experimental measurements are presented.

8086 **Development of magnetic probe and Rogowski coil in JT-60.** Hosogane, N.; Aikawa, H.; Matobu, T.; Ogiwara, N.; Suzuki, Y.; Yamamoto, M. (Japan Atomic Energy Research Institute, Fusion Research Center). pp 305-308 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

In order to measure the plasma displacement and the plasma current in real time, the magnetic probes and the Rogowski coils should be installed inside the vacuum vessel to avoid the magnetic shielding effect of the thick wall. So we developed the magnetic probes and the Rogowski coils which can be used under the severe condition of the inside of the vessel of JT-60. The design specifications of these detectors are as follows; 1) heat condition: 500°C, 2) X-ray irradiation: 2 x 10^8 Roentgen/life, 3) electric insulation voltage: 1.1 kV AC, 4) vacuum leak conditions: $<5 \times 10^{-10}$ Torr X l/sec, 5) vibration condition: 9.7 G(acceleration), 6) frequency response: (gain variation) <0.5dB, (phase delay) $<5^{\circ}$ in the range of DC to 1 kHz. Besides, the installation problem and the vacuum maintenance problem of the vessel are taken into consideration.

8087 **Design of the Plasma Current Sensor diagnostic for MFTF-B.** Goerz, D.A.; House, P.A.; Wells, C.W. (Lawrence Livermore National Laboratory, Livermore, CA). pp 300-304 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The Plasma Current Sensor (PCS) diagnostic includes large diamagnetic loops (DL) that fully encircle the plasma as well as small multi-turn pickup coils (PCs) located between the plasma and the superconducting magnets. Both types of sensors respond to changing magnetic flux linkages caused by plasma currents and are used to measure plasma diamagnetism, from which estimates of temperature and density can be made. The DLs are used in the central cell and Axicell regions, while the PCs are used in the Yin-yang regions where DLs are impractical. Other PCs are used in the central cell to detect axial plasma currents, to help tune trim coils

in the transition cell and confirm theoretical estimates of radial diffusion limits. This paper describes the PCS diagnostic and presents the detailed mechanical and electrical designs.

8088 **Design of the electromagnetic fluctuations diagnostic for MFTF-B.** House, P.A.; Goerz, D.A.; Martin, R. (Lawrence Livermore National Laboratory, Livermore, CA). pp 295-299 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The Electromagnetic Fluctuations (EMF) diagnostic will be used to monitor ion fluctuations which could be unstable in MFTF-B. Each probe assembly includes a high impedance electrostatic probe to measure potential fluctuations, and a group of nested, single turn loops to measure magnetic fluctuations in three directions. Eventually, more probes and loops will be added to each probe assembly for making more detailed measurements. The sensors must lie physically close to the plasma edge and are radially positionable. Also, probes at separate axial locations can be positioned to connect along the same magnetic field line. These probes are similar in concept to the RF probes used on TMX, but the high thermal load for 30-second shots on MFTF-B requires a water-cooled design along with temperature monitors. Each signal channel has a bandwidth of .001-150 MHz and is monitored by up to four different data channels which obtain amplitude and frequency information. This paper describes the EMF diagnostic and presents the detailed mechanical and electrical designs.

8089 **Control of rapid plasma motions in the Tokamak de Varennes.** Kalnavarns, J.; Pacher, G.W.; Pacher, M.D. (MPB Technologies Dorval, Quebec). pp 122-126 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The position feedback system of the Tokamak de Varennes is modelled using realistic representations of the vacuum vessel and the power supplies. In this study the loop behaviour is examined in the time domain for scenarios approximating internal disruptions and rapid plasma current rampdown. With appropriate pre-programming, satisfactory response is demonstrated.

8090 **Three dimensional ballooning mode stability for stellarators.** Berk, H.L.; Rosenbluth, M.H.; Shohet, J.L. (University of Texas, Austin, TX). pp 80-81 of 1983 IEEE interation conference on plasma science. New York, NY; IEEE (1983). (CONF-830590—).

From IEEE international conference on plasma science; San Diego, CA, USA (25 May 1983).

Abstracts Only.

We have developed an efficient way to compute ballooning mode and Mercier stability for a stellarator configuration of moderate beta. The method relies on utilizing a vacuum field line solver due to a given set of coils. Then given a Clebsch representation of the magnetic field, and using the standard for toroidal angle as the third coordinate, one can express the ballooning mode equation in terms of the contravariant vector E_s. To within a normalization factor, E_s is then the difference of two neighboring points on the same flux surface at constant /PHI/. This vector is easily calculated from a field line following code. One can also construct the Mercier stability condition from the provided set of equations and observe whether ballooning mode localization for the Mercier condition determines stability.

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REFER ALSO TO CITATION(S) 8080, 8089, 8089, 8154

8091 **(CONF-850920—7) Internal pressure effects in the AIRCO-LCT conductor sheath.** Luton, J.N.; Clinard, J.A.; Lue, J.W.; Gray, W.H.; Summers, L.T.; Kershaw, R. (Oak Ridge National Lab., TN (USA); Lawrence Livermore National Lab., CA (USA)). 1985. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002215.

From 9. international conference on magnet technology; Zurich, Switzerland (9 Sep 1985).

The large Nb_3Sn superconducting test coil produced by Westinghouse Electric Corporation for the international Large Coil Task (LCT) utilizes a conductor composed of cabled multifilamentary strands immersed in flowing supercritical helium contained by a square structural sheath made of the high-strength stainless alloy JBX-75. Peak pressures of a few hundred atmospheres are predicted to occur during quench, and measurement of these pressures seems feasible only through penetrations of the sheath wall. Fully processed short lengths of conductor were taken from production ends, fitted with pressure taps and strain gauges, and pressurized with helium gas. Failure, at 1000 atm at liquid nitrogen temperature, was by a catastrophic splitting of the sheath at a corner. Strain measurements and burst pressure agreed with elastic-plastic finite element stress calculations made for the sheath alone. Neither the production seam weld nor the pressure tap penetrations or their fillet welds contributed to the failure, although the finite element calculations show that these areas were also highly stressed, and examination of the failed sample showed that the finite welds were of poor quality. Failure was by tensile overload, with no evidence of fatigue.

8092 **(CONF-851102—5) Protection considerations for force-cooled superconductors.** Dresner, L. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003008.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

This paper treats some hydrodynamic aspects of protecting magnets wound with force-cooled superconductors, namely, the rise in internal pressure and the forceful expulsion of helium during a quench. Two initial conditions are considered: an entire hydraulic path going normal all at once, and an initially small but nonrecovering normal zone. Formulas are given for the quench pressure and expulsion velocity in both cases and are compared with available experimental data.

8093 **(CONF-851102—12) Design of deuterium and tritium pellet injector systems for Tokamak Fusion Test Reactor.** Wysor, R.B.; Baylor, L.R.; Bryan, W.E.; Combs, S.K.; Fisher, P.W.; Lunsford, R.V.; Maxon, B.S.; Milora, S.L.; Webster, D.J.; Schmidt, G.L. (Oak Ridge National Lab., TN (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.). 1985. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003323.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

Three pellet injector designs developed by the Oak Ridge National Laboratory (ORNL) are planned for the Tokamak Fusion Test Reactor (TFTR) to reach the goal of a tritium pellet injector by 1988. These are the Repeating Pneumatic Injector (RPI), the Deuterium Pellet Injector (DPI) and the Tritium Pellet Injector (TPI). Each of the pellet injector designs have similar performance characteristics in that they deliver up to 4-mm-dia pellets at velocities up to 1500 m/s with a dsign goal to 2000 m/s. Similar techniques are utilized to freeze and extrude the pellet material. The injector systems incorporate three gun concepts which differ in the number of gun barrels and the method of forming and chambering the pellets. The RPI, a single barrel repeating design, has been operational on TFTR since April 1985. Fabrication and assembly are essentially complete for DPI, and TPI is presently on hold after completing about 80% of the design. The TFTR pellet injector program is described, and each of the injector systems is described briefly. Design details are discussed in other papers at this symposium.

8094 **(CONF-851102—13) Tritium pellet injector design for tokamak fusion test reactor.** Fisher, P.W.; Baylor, L.R.; Bryan, W.E.; Combs, S.K.; Easterly, C.E.; Lunsford, R.V.; Milora, S.L.; Schuresko, D.D.; White, J.A.; Williamson, D.H. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003312.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

A tritium pellet injector (TPI) system has been designed for the Tokamak Fusion Test Reactor (TFTR) Q ~ 1 phase of operation. The injector gun utilizes a radial design with eight independent barrels and a common extruder to minimize tritium inventory. The injection line contains guide tubes with intermediate vacuum pumping stations and fast valves to minimize propellant leakage to the torus. The vacuum system is designed for tritium compatibility. The entire injector system is contained in a glove box for secondary containment protection against tritium release. Failure modes and effects have been analyzed, and structural analysis has been performed for most intense predicted earthquake conditions. Details of the design and operation of this system are presented in this paper.

8095 (CONF-851102—14) Simple contour analysis of ignition conditions and plasma operating regimes in tokamaks. Uckan, N.A.; Sheffield, J.; Selcow, E.C. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003324.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

Contour plots of ignition, auxiliary power requirements, heating and operating windows, optimal path to ignition, ignition margin, etc., are generated analytically in terms of a small number of parameters (aB_0^2/q/sub */, $\langle n \rangle R_0/B_0$, $\langle T \rangle$, etc.) for classes of devices with equivalent performance. Numerical studies are carried out to map the physics design space. Considering both the Murakami density limit ($\sim B_0/R_0$) and the Troyon beta limit ($\sim I/aB_0$), results from analytic calculations indicate that in a standard tokamak geometry (A ~ 2.5 to 3.5, $\kappa = b/a \sim 1.6$ to 1.7, q/sub psi/ ~ 2.6) devices with aB_0^2/q/sub */ ~ 20 should be ignitable provided confinement does not degrade with heating (ohmic + alpha + auxiliary, etc.) power; however, aB_0^2/q/sub */ ~ 30 (25) may be required for minimal ignition for a typical L- (H-) mode confinement scaling. Increased plasma elongation ($\kappa \sim 2$) may help to reduce these requirements.

8096 (CONF-851102—15) Deuterium pellet injector gun design. Lunsford, R.V.; Wysor, R.B.; Bryan, W.E.; Shipley, W.D.; Combs, S.K.; Foust, C.R.; Milora, S.L.; Fisher, P.W. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 4p. NTIS, PC A02 - GPO. File Number DE86003315.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

The Deuterium Pellet Injector (DPI), an eight-pellet pneumatic injector, is being designed and fabricated for the Tokamak Fusion Test Reactor (TFTR). It will accelerate eight pellets, 4 by 4 mm maximum, to greater than 1500 m/s. It utilizes a unique pellet-forming mechanism, a cooled pellet storage wheel, and improved propellant gas scavenging.

8097 (CONF-8511126—2) Electromagnetic properties of LCT coils. Shen, S.S. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 4p. NTIS, PC A02. File Number DE86003319.

From International symposium on flux pinning and electromagnetic properties in superconductors; Fukuoka, Japan (11 Nov 1985).

One of the major objectives of the Large Coil Task (LCT) is to demonstrate that large-scale magnet systems can be operated stably and safely while subjected to external transient disturbances. This paper reviews the design of the conductor and the coil structure of all six LCT coils with special emphasis on their ac loss properties. The function and capability of the test facility and the test scheme are also summarized. Finally, the interpretation of the test results and its relevance to practical large-scale applications are presented.

8098 (DOE/ER/13302—1) Production of ultrahigh magnetic fields. Technical progress report. (JAYCOR, San Diego, CA (USA)). 25 Oct 1985. Contract FG03-84ER13302. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86003735.

The objective was to produce and measure controlled ultrahigh magnetic fields by imploding a plasma in which a magnetic field has been entrained. The novel method for producing the ultrahigh fields using a gas-puff Z pinch was tested successfully and found to work as well as predicted in some respects and better in others, such as field amplification. Moreover, in testing this concept, we may have created the only megagauss facility in the world with a 3-minute repetition rate and long lifetime. Most megagauss facilities are single-shot, owing to material deformations or the use of explosives.

8099 (DOE/ER/52085—T1) Experience with magnetic accidents. Phase II report. Czirr, J.B.; Thome, R. (MESA Corp., Salt Lake City, UT (USA)). 18 Jan 1984. Contract AC01-82ER52085. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86001844.

This report presents results from an ongoing operating-safety study which is being conducted in support of the safety analyses at the Large Coil Test Facility (LCTF), Oak Ridge, Tennessee. The purpose of this study is to provide the facility operators and users with added insight into potential problem areas that could affect the safety of personnel or the availability of equipment. Section 2.0 includes a description of the coil-protection circuits and discusses potential failure modes that could endanger the coils. The section concludes with recommendations for improving the safety and reliability of the facility. Section 3.0 is an analysis of a short circuit in one of the domestic coils that was observed during the coil winding. Recommendations were given previously for removing the material that caused the short circuit and these recommendations are documented in this sections.

8100 (DOE/ET/51013—163) Pool-cooled superconducting coils: past, present and future. Thome, R.J.; Dawson, A.M. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Aug 1985. Contract AC02-78ET51013. 18p. (PFC/CP—85-8; CONF-850814—31). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003357.

From Cryogenic engineering conference and international cryogenic materials conference; Boston, MA, USA (12 Aug 1985).

An overview of large magnet systems which have been studied, constructed, or operated in the last 12 years is presented and shows a substantial advance in overall current density, stored energy, and magnet complexity. The preferable coolant mode for very large magnets is still a bath of helium I, but it is clear that other coolant modes are gaining acceptance. The data base for design using stability criteria dependent on transients has expanded to the point where the risk is often acceptable, compared to the lower current density, low risk, steady state stability criteria which launched large superconducting magnet technology. The limitation imposed by structure and protection on increasing overall current density in large magnets is discussed and a simple model is used to illustrate the extreme requirements imposed on a winding without direct helium contact. The latter implies that a significant technological step is required before conduction cooling or indirect cooling will be used in the large magnets envisioned for the future and that helium contact with the conductor will remain the key ingredient for risk reduction in large magnet design.

8101 (LA-UR—85-3850) FRX-C Large Source Modification. Chrien, R.E.; Tuszewski, M.; Yavornik, E.J.; Barnes, G.A.; Armstrong, W.T.; Hugrass, W.N.; Klingner, P.L.; McKenna, K.F.; Okada, S.; Rej, D.J. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-8511118—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002428.

From 7. US-Japan workshop on compact toroids; Bellevue, WA, USA (12 Nov 1985).

The FRX-C Large Source Modification (LSM) consists of a larger discharge tube and a larger radius coil connected to the existing FRX-C collector plates and capacitor banks. The objectives of LSM are to (1) study the size dependences of processes governing FRC formation and poloidal flux trapping in order to improve the design of larger field-reversed theta pinch devices, (2) increase the parameter s (number of local ion gyroradii between the field null and separatrix) to seek access to predicted new regimes of im-

proved confinement and possible instability, (3) search for evidence of internal tilt instability at higher values of s where the mode is predicted to grow more rapidly, and (4) observe the effect of s and larger size on FRC confinement. In this paper we will discuss the construction of LSM, the experimental plan, and preliminary experimental results.

8102 **(LA-UR—85-3851) Los Alamos KrF laser program.** Jensen, R.J.; Cartwright, D.C. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 11p. (CONF-851053—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002427.

From 7. international workshop on laser interaction and related plasma phenomena; Monterey, CA, USA (28 Oct 1985).

Los Alamos is currently developing the krypton fluoride (KrF) laser - a highly efficient laser able to emit very intense bursts of short-wavelength photons - as a research tool for the general study of high-density matter, as well as for use in laser fusion. The KrF laser operates at 1/4 μm, close to the short-wavelength limit for conventional optical material, but still in the region where standard optical techniques can be used. The excited-state lifetime of the KrF lasing medium is short - as a result of both spontaneous emission and deactivation from collisions - making it impossible to store energy within the lasing medium for times significant to electrical pumping. However, an optical multiplexing scheme is being developed that will generate short, intense pulses of 1/4-μm light by overcoming the short storage time of the laser and taking advantage of the high gain of the KrF medium.

8103 **(LA-UR—85-3855) Heavy ion beam transport through liquid lithium first wall ICF reactor cavities.** Stroud, P.D. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 23p. (CONF-851053—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86002425.

From 7. international workshop on laser interaction and related plasma phenomena; Monterey, CA, USA (28 Oct 1985).

This analysis addresses the critical issue of the final transport of a heavy ion beam in an inertial confinement fusion reactor. The beam must traverse the reaction chamber from the final focusing lens to the target without being disrupted. This requirement has a strong impact on the reactor design. It is essential to the development of ICF fusion reactor technology, that the restrictions placed on the reactor engineering parameters by final beam transport consideration be understood early on.

8104 **(SAND—85-1266C) Retention and thermal release of oxygen implanted in graphite.** Wampler, W.R.; Brice, D.K. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 11p. (CONF-851174—15). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003235.

From 32. national vacuum symposium and topical conference; Houston, TX, USA (19 Nov 1985).

The retention of oxygen implanted in graphite at 1.5 and 3 keV was measured as a function of fluence. At fluences less than 10^{16} 0/cm^2 the oxygen was all retained, but at higher fluences the retention saturated. Models describing the retention are discussed which include the effects of sputtering and a saturation limit to the local oxygen concentration. Thermal release of oxygen implanted to saturation at room temperature began at 250°C and was 90% completed by 750°C.

8105 **(SAND—85-1741) Development of a twelve-plasma gun, single-pulser combination for use in the PBFA-I Hybrid Ion Diode.** McKay, P.F. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1985. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003797.

A twelve-plasma gun, single-pulser combination for use in the PBFA-I 15-cm Hybrid Ion Diode is described. Each gun will generate a plasma density of 1 x 10^{12} cm^{-3} at a distance of 15 cm. Included are results of preliminary experiments to determine the required pulser energy and a practical gun geometry. 6 refs., 6 figs., 5 tabs.

8106 **(UCRL—90938) Microspot target development with seeded and patterned plasma polymers.** Letts, S.A.; Miller, D.E.; Corley, R.A.; Tillotson, T.M.; Witt, L.A. (Lawrence Livermore National Lab., CA (USA)). 10 Dec 1984. Contract W-7405-ENG-48. 11p. (CONF-841218—28). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002621.

From 31. national vacuum symposium; Reno, NV, USA (3 Dec 1984).

A new class of targets for laser fusion experiments was fabricated using plasma-deposition and etching technology. Plasma polymer coatings seeded with silicon or sulfur were deposited as 300μm diameter microspots inside holes of equal diameter in a pure hydrocarbon polymer film. The target was designed to study large-scale plasma instabilities and measure the temperature and density histories of laser induced plasmas. The microspot target required three new development: freestanding stress-free CH films, technology to define and form holes in CH films, and development of seeded films deposited as 300μm diameter discs, nested tightly in the precision holes. Hydrocarbon films were deposited by plasma polymerization or by solution casting (polystyrene in dichloromethane) onto potassium-chloide-coated glass slides. Holes were defined either by masking with a 300μm diameter disc or by reactive ion etching through a washer mask. Sulfur or silicon seeded CH polymer microspots were deposited through a mask using plasma polymerization. Seeded polymer films were prepared with compositions as high as 12 atomic percent, with most diagnostic targets made with 2 a/o. Silicon seeded polymers, when deposited at 750 mtorr (100 Pa) pressure, wer transparent and colorless.

8107 **(UCRL—92528) Mechanical configuration for a superconducting ignition tokamak (TIBER).** Neef, W.S. Jr.; Johnston, B.M. (Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 7p. (CONF-851102—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002965.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

The Lawrence Livermore National Laboratory is evaluating the engineering feasibility and economics of a superconducting ignition tokamak. Two major operational requirements had to be satisfied: (1) the conductive heat leak to the refrigerated structure had to be minimized, and (2) assembly and maintenance of the entire experiment had to be possible with remotely operated tools. The middle poloidal "push coil" must have many annular disks to transfer the TF-coil inward force to the post without crushing superconductor. The toppling moment on the TF-coil vertical legs is huge. A method of keying together the TF-coil cases has been developed. This forms an integrated structure that resists torque. The joining technique permits linear motion for simple assembly/disassembly. the topping moment on the outer vertical legs of the TF coils is very large. To react that moment and avoid great coil-case bulk, we have developed a method that allows the PF coil support structure to assist the TF case structure. Finite element techniques were used to determine the ability of the coal case and conductor to react the magnetic loads. The entire cold-coil structure is mounted on a circular plate that is suspended by several large tension rods, similar to the MFTF-B yin-yang support rods. The vacuum vessel is all at room temperature and is configured like a bell jar with sixteen side doors, one for each shield module.

8108 **(UCRL—92558) Cascade inertial-confinement-fusion power plant.** Pitts, J.H.; Maya, I. (Lawrence Livermore National Lab., CA (USA); California State Univ., Long Beach (USA)). 13 Nov 1985. Contract W-7405-ENG-48. 5p. (CONF-851102—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003195.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

The Cascade reactor is double-cone shaped with a maximum radius of 5 m. It rotates at 50 rpm. The average temperature of a three-material flowing granular blanket leaving the reactor is 1440 K. Heat from the blanket is transferred to helium gas in a shell- and ceramic-tube-type heat exchanger that has a separate region for each blanket material. Diffusion of tritium from the blanket granules through the heat exchanger is only 25 Ci/d, so no intermediate

loop is needed for isolation. We selected a simple once-through, regenerative, 5-MPa helium gas-turbine (Brayton) cycle for power conversion because of its simplicity and high efficiency. Fusion power is 1500 MW; this is multiplied to 1670 MW/sub t/ in the blanket. Power conversion efficiency is 55%. Net electric power is 815 MW/sub e/, produced with a net plant efficiency of 49%.

8109 **(UCRL—92623) Ion cyclotron resonance heating (ICRH) start-up antenna for the mirror fusion test facility (MFTF-B).** McCarville, T.M.; Romesser, T.E. (TRW, Inc., Redondo Beach, CA (USA)). 2 Oct 1985. Contract W-7405-ENG-48. 6p. (CONF-851102—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002376.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

The purpose of the ICRH start-up antenna on MFTF-B is to heat the plasma and control the ion distribution as the density increases during start-up. The antenna, consisting of two center fed half turn loops phased 180° apart, has been designed for 1 MW of input power, with a goal of coupling 400 kW into the ions. To vary the heating frequency relative to the local ion cyclotron frequency, the antenna is tunable over a range from 7.5 to 12.5 MHz. The thermal requirements common to low duty cycle ICRH antennas are especially severe for the MFTF-B antenna. The stress requirements are also unique, deriving from the possibility of seismic activity or JxB forces if the magnets unexpectedly quench. Considerable attention has been paid to contact control at high current bolt-up joints, and arranging geometries so as to minimize the possibility of voltage breakdown.

8110 **(UCRL—92700-Rev.1) Nuclear spin polarization of solid deuterium-tritium. Revision 1.** Souers, P.C.; Fearon, E.M.; Mapoles, E.R.; Gaines, J.R.; Sater, J.D.; Fedders, P.A. (Lawrence Livermore National Lab., CA (USA); Ohio State Univ., Columbus (USA); Washington Univ., St. Louis, MO (USA)). 1985. Contract W-7405-ENG-48. 26p. (CONF-851174—1-Rev.1). NTIS, PC A03/MF A01; GPO Dep. File Number DE86002171.

From 32. national vacuum symposium and topical conference; Houston, TX, USA (19 Nov 1985).

It appears that parallel alignment of deuteron and triton magnetic moments increases the cross section of the nuclear reaction T(d,n) He^4 by 50%, thereby promising a laser driver of perhaps half the original energy. Both "brute-force" and dynamic nuclear polarization are considered, and the many potential problems of the latter are considered. High nuclear polarization by the dynamic technique requires a small nucleus-to-unpaired electron ratio, a long longitudinal nuclear relaxation time and a short longitudinal electron relaxation time. Normal D-T is shown to be inadequate, and enriched and possibly very pure molecular DT will be required. The key variable is the nuclear relaxation time, which can either depend on the interaction with rotationally excited impurity molecules or on paramagnetic defects formed by the tritium radiation. Radiation-induced DT decomposition and rotational catalysis will combat one another to affect the DT purity. The expected atom density and fractionation effects are considered. There exists one frequency at which both D and T atoms can be pumped.

8111 **(UCRL—93356-Rev.1) Tritium gettering from air with hydrogen uranyl phosphate. Revision 1.** Souers, P.C.; Uribe, F.S.; Stevens, C.G.; Tsugawa, R.T. (Lawrence Livermore National Lab., CA (USA)). 1985. Contract W-7405-ENG-48. 25p. (CONF-851174—6-Rev.1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003481.

From 32. national vacuum symposium and topical conference; Houston, TX, USA (19 Nov 1985).

Hydrogen uranyl phosphate (HUP), a solid proton electrolyte, getters tritium gas and water vapor from air by DC electrical action. We have reduced the formation of residual tritiated water to less than 2%, and demonstrated that HUP can clean a 5.5 m^3 working glove box. Data are presented to illustrate the parameters of the gettering and a model is derived. Two other tritium gettering electrolytes have been discovered. 9 refs., 5 figs., 3 tabs.

8112 **EBT-P magnet development program summary.** McManamy, T.J.; Ballou, J.K.; Lue, J.W.; Mann, T.L.; Shen, S.S.; Wilson, C.T. (Oak Ridge National Laboratory, Oak Ridge, Tennessee). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **MAG 21**: No. 2, 1071-1074(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

The ELMO Bumpy Torus Proof-of-Principle Magnet Development Program, which began in 1979, has fabricated and tested three NbTi superconducting magnets. The magnets are metastable with a maximum winding pack current density of 10,000 A/cm^2 at a peak field of 7.4 T. Each magnet has been installed in a closefitting dewar with a warm bore. Previous publications have reported successful tests of the first two windings in a large dewar, tests of the first complete magnet in its own dewar, and construction details of the dewars. This paper gives procedures and results for the test of the third winding in an open dewar, the test of the second single magnet in its own dewar, and two tests in which two magnets were run in series to generate a 73,000-lb side load at 5 T. The last tests verified the mechanical integrity of the design and qualified two of the magnets for use in the National Radio Frequency Test Facility.

8113 **Shorts due to diagnostic leads.** Ellis, J.F.; Lubell, M.S.; Pillsbury, R.D.; Shen, S.S.; Thome, R.J.; Walstrom, P.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **MAG 21**: No. 2, 1060-1063(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

The superconducting toroidal field coils that are being tested in the Large Coil Test Facility (LCTF) are heavily instrumented. General Electric coil, a lead wire of an internal sensor became shorted across an estimated three or four turns of the pancake winding. This short occurred during the final stages of the winding fabrication and was not accessible for repair. Resistance, voltage gradient, and transient voltage decay measurements were performed to characterize the short and the magnetic damping of the large steel bobbin and outer structural ring. The 32-gage wire causing the short was estimated to be about 10 cm long, with a resistance of 55 mΩ. As a safety measure, we decided to burn out the shorted wire at room temperature before installing the coil in LCTF. Tests were made to determine the energy needed to vaporize a small wire. Computer calculations indicated that within the voltage limits set for the coil, it was not feasible to burn out the wire by rapidly dumping the coil from a low-current dc charge-up. We accomplished the burnout by applying 800 V at 3.25 A, and 60 Hz for about 1 s. Transient voltage decay measurements made after the burnout and compared with those made before the attempt confirmed that the short had indeed been opened.

8114 **Preliminary results of the partial-array LCT coil tests.** Luton, J.N.; Cogswell, F.D.; Dresner, L.; Ellis, J.F.; Fietz, W.A.; Friesinger, G.M.; Gray, W.H.; Iwasa, Y.; Koizumi, K.; Lubell, M. (Oak Ridge National Laboratory, Oak Ridge, TN). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **MAG 21**: No. 2, 238-241(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

The Large Coil Task (LCT) is a collaboration between the US, Euratom, Japan, and Switzerland for the production and testing of 2.5 x 3.5 m bore, superconducting 8-T magnets. The definitive tests in the design configuration, the six coils arrayed in a compact torus, will begin in 1985. Partial-array tests are being done in 1984. In January the initial cooldown of two coils was aborted because of heliumto-vacuum leaks that developed in certain seal welds when the coil temperatures were 170 to 180 K. In July three adjacent coils (designated JA, GD, CH) were cooled, and in August two were energized to the limits of the test facility. An overview of the results is presented, including facility, cooldown, energization, dump, recovery from intentional normal zones, strain, and displacement, for operation up to 100% of design current but below full field and stress. These initial results are highly encouraging.

8115 Experience highlights from the design and manufacture of US LCT coils. Kibbe, R.K.; Amonett, C.M.; Benson, R.D.; Hussung, R.O.; Shipley, W.D. (Oak Ridge National Laboratory, Oak Ridge, TN). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG 21: No. 2, 234-237(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

The international Large Coil Task (LCT) is a major activity in the development of superconducting toroidal field (TF) coils for tokamak fusion reactors. The technical objective of this program is to design, build, and test six large TF coils, thereby producing information and data that can be used directly by program planners and designers of tokamak reactors. After an intensive competetive bidding cycle, contracts were awarded in 1977 to three US industrial firms for the design and manufacture of test coils. Subsequently Japan, EURATOM, and Switzerland agreed to supply one coil each. External dimensions and minimum performance requirements are identical but freedom was allowed in the choice of internal design and manufacturing techniques. All six coils will be tested in a compact toroidal array in the Large Coil Test Facility (LCTF) in Oak Ridge, Tennessee. With the coil fabrication phase approaching completion, it is an appropriate time to review the major technical challenges and lessons from the design and manufacture of the three US LCT coils.

8116 Comprehensive design procedure and spreadsheet for international cooled cabled superconductors. Materna, P. (Princeton Plasma Physics Laboratory, Princeton, NJ). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG 21: No. 2, 1091-1094(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

A comprehensive procedure has been set up to consider together the various phenomena influencing the design of an Internally Cooled Cabled Superconductor (ICCS). Sensitivity studies done for TFCX show the relative order of importance of conduit structural behavior assumption, dump circuit design, and nuclear heating rate on the cavity current density. Although none of these is completely specified or known presently, the TFCX TF coil design goal of 3500 A/cm^2 at 10 Tesla appears achievable using moderately optimistic assumptions. The study was done in an automated manner using spreadsheet software on a personal computer, which proved to be extremely convenient and flexible.

8117 Fabrication and evaluation of a cryostable Nb_3Sn superconductor for the Mirror Fusion Test Facility (MFTF-B). Scanlan, R.M.; Baldi, R.W.; Furuto, Y.; Ikeda, M.; Meyuro, S.; Pickering, J.L.; Zbasnik, J.P. (Lawrence Livermore National Laboratory, Livermore, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG 21: No. 2, 1087-1090(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

The MFTF-B magnet system requires two 12.5T, 36 cm bore, insert coils. These coils are being constructed with a cryostable Nb_3Sn conductor manufactured by Furukawa Electric Co. The conductor consists of a core soldered into a cold-worked copper housing, which provides strength. The Nb_3Sn core is made by a triple extrusion bronze process. A total of 57 lengths, each 295 m long, have been made and tested. We have made extensive tests on this conductor; these tests include critical current, ambient and 4.2 K mechanical property measurements, critical current as a function of tensile strain, and bending tolerance tests. The critical current density was found to be quite anisotropic in this conductor, with J/sub c/ (12T) = 650A/mm^2 for field perpendicular to the conductor wide face, and J/sub c/ (12T) = 500A/mm^2 for field parallel to the conductor wide face. These values are among the highest reported for a production lot of Nb_3Sn conductor.

8118 Computer simulation of multiple stability regions in an internally cooled superconducting conductor and of helium replenishment in a bath-cooled conductor. Turner, L.R.; Shindler, J. (Fusion Power Program, Argonne National Laboratory, Argonne, Illinois 60439). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG 21: No. 2, 1083-1086(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

For upcoming fusion experiments and future fusion reactors, superconducting magnets have been chosen or considered which employ cooling by pool-boiling HeI, by HeII, and by internally flowing HeI. The choice of conductor and cooling method should be determined in part by the response of the magnet to sudden localized heat pulses of various magnitudes. The paper describes the successful computer simulation of multiple stability in internally cooled conductors, as observed experimentally, using the computer code SSICC. It also describes the modelling of helium replenishment in the cooling channels of a bath-cooled conductor, using the computer code TASS.

8119 Vapor-cooled lead and stacks thermal performance and design analysis by finite difference techniques. Peck, S.D.; Christensen, E.H.; O'Loughlin, J.M. (General Dynamics, Convair Division, San Diego, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG 21: No. 2, 1099-1102(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

Investigation of the combined thermal performance of the stacks and vapor cooled leads for the Mirror Fusion Test Facility-"B" demonstrates considerable interdependency. For instance, the heat transfer to the vapor-cooled lead (VCL) from warm bus heaters, environmental enclosure, and stack is a significant additional heat load to the joule heating in the leads, proportionately higher for the lower current leads that have fewer current-carrying, counter flow coolant copper tubes. Consequently, the specific coolant flow (G/sec-kA-lead pair) increases as the lead current decreases. The definition of this interdependency and the definition of necessary thermal management has required an integrated thermal model for the entire stack/VCL assemblies.

8120 High-performance TF coil design for the Tokamak Fusion Core Experiment (TFCX). Srivastava, V.C. (Fusion Engineering Design Center/General Electric Company, Oak Ridge National Laboratory, Oak Ridge, Tennessee). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* MAG 21: No. 2, 1067-1070(Mar 1985). (CONF-840937—).

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

The Tokamak Fusion Core Experiment (TFCX) is a proposed concept for an ignited, long-pulse, currentdriven tokamak device. Toroidal field (TF) coil winding cross section in the inboard region is impacted by peak field (10 T), winding current density (about 3500 A/cm^2), and peak nuclear heating rates (50 mW/cm^3). The winding utilizes a Nb_3Sn internally cooled cable superconductor (ICCS), which is a modified version of the conductor used in the Westinghouse Large Coil Program (LCP) coil. These modifications include the increase of void fraction from 32% to 41% of the cable space for withstanding higher nuclear heating rates and a thicker conduit wall to carry larger magnetic loads. The critical current of a Nb_3Sn conductor is strongly dependent on strain in the superconducting strands. The strain in strands is lower when the windings are wound and then reacted (W/R), as compared to reacted and then wound (R/W). The impact of these approaches on winding performance is discussed. The windings are pancake wound and cooled with supercritical helium. The liquid helium (LHe) inlet (about 4 K) and outlet (about 5.5 K) connections are located on the sides of the TF coils. The conductor design, the winding design, and performance analysis are described.

8121 **The fusion breeder--an early application of nuclear fusion.** Berwald, D.H.; Lee, J.D.; Moir, R.W.; Teller, E. (TRW, Inc., Redondo Beach, California). *Fusion Technology;* 6: No. 3, 584-596(Nov 1984).

Recent fusion breeder work and how breeding can be an early application of fusion R & D are reviewed. Fusion breeders are fusion reactors designed specifically to produce fissile fuel for fission reactors such as the light water reactor (LWR). Two kinds of fusion breeders are reviewed. The first uses a blanket designed to multiply neutrons by fissioning the abundant isotopes of ^{238}U and ^{232}Th. This design is predicted to produce enough fissile fuel for four or more LWRs and produces so much energy in the blanket that fusion performance can be reduced to a level technologically feasible within the next 10 to 15 years. The second kind of fusion breeder uses a blanket designed to suppress fission, which enhances safety by the nonfissioning multiplication of neutrons in beryllium. This fissionsuppressed fusion breeder is predicted to produce enough fissile fuel for ten or more LWRs of equal thermal power. Either kind of fusion breeder has the potential to provide a source of reasonably priced fissile fuel after the low-cost natural uranium fuel supply is gone. Thus, rapid expansion of conventional nuclear power could be provided, if necessary, to meet our nearer term needs, while at the same time providing an early application of nuclear fusion that could accelerate the commercial development of a fusion electricity generation technology to follow.

8122 **A d-d tandem mirror reactor assessment.** Dobrott, D.; Gurol, H.; Shug, G.W. (Science Applications Inc., La Jolla, CA). pp 111-114 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

A conceptual tandem mirror reactor (TMR) that is fueled by the catalyzed-deuterium fuel cycle is assessed with respect to physics, technology, safety, and cost. A comparison with respect to these issues is made between this reactor and a deuterium-tritium fueled TMR similar to that developed for the MARS study. Both designs have ends stoppered by a combination of magnetic and electrostatic fields and fusion takes place within the solenoid. The magnetic field end plugs are formed by a combination of 24 Tesla coils and a system of 8 Tesla yin-yang coils to provide stability. The ambipolar potential electron and ion plugs are formed in the yin-yangs and are created by a combination of neutral beams and electron cyclotron resonance heating (ECRH). Fusion power is converted to electricity in a TMR by two methods: by volumetric heat generation from neutron bombardment in the blanket and by direct conversion of the energy from changed particles escaping from the ends of the TMR. Thermal energy from neutrons is converted more efficiently for a Cat-d TMR because of relative blanket simplicity. Both Cat-d and d-t TMRs can utilize high efficiency direct conversion, but the former has a greater percentage of fusion power in charge particles. The total activation of the first wall and blanket due to neutron bombardment is similar for the Cat-d and d-t TMRs, but the tritium inventory is about three orders of magnitude greater in the latter. It is determined that although the Cat-d TMR operates at a higher ion temperature and is generally larger than a d-t TMR, the first wall and blanket lifetimes are an order of magnitude larger, and the capital costs are comparable for the same net power output.

8123 **Poloidal field coil and current distribution study for the Toroidal Fusion Core Experiment (TFCX).** Srivastava, V.C.; Miller, J.B.; Strickler, D.J. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 106-110 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The Toroidal Fusion Core Experiment (TFCX) is a proposed concept for an ignited, longpulse, current-driven, "next step" tokamak device. The poloidal field (PF) coil configuration has major impact on the size and cost of a tokamak machine. The purpose of this trade study was to determine the achievable values of plasma triangularity and elongation consistent with mechanical configuration and plasma performance requirements. The study was made with three sets of PF coil configurations: PF coils external to the toroidal field (TF) coil, all PF coils inside the TF coil bore, and a hybrid configuration with some coils inside and some outside of the TF coil bore. The impact of plasma shape, profile, and coil locations on the distance between the plasma boundary and separatrix are presented. It is concluded that the plasma scrape-off requirements for removing impurities with a single null limiter can only be satisfied if the triangularity is limited to about 0.30 for an elongation of 1.6.

8124 **Tandem mirror experiment upgrade (TMX-U) throttle, mechanical design, construction, installation, and alignment.** Pedrotti, L.R.; Wong, R.L. (Lawrence Livermore National Laboratory, Livermore, CA). pp 714-718 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

We will soon add a high-field axisymmetric throttle region to the central cell of the TMX-U. Field amplitude will be adjusted between 2.25 and 6.0 T. This field is produced by adding a high-field solenoid and a cee coil to each end of the central cell. We describe these coils as well as the additions to the restraint structure. We analyzed the stresses within the solenoid using the STANSOL code. In addition, we performed a finite-element structural analysis of the complete magnet set with the SAP4 code. Particular attention was paid to the transition section where the new magnets were added and where the currents in the existing magnets were increased. The peak temperature rise in the throttle coil was calculated to be 41°C above ambient.

8125 **Electrical test and test result evaluations of TFTR toroidal field (TF) and poloidal field (PF) coils.** Meighan, T.G.; Alton, R.J. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey). pp 886-891 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

This paper describes all electrical tests conducted on the Toroidal Field (TF) and Poloidal Field (PF) magnetic coils for TFTR. It will, for each test sequence, present an evaluation of the results and, where applicable, discuss measures adopted to explain any anomalies which occurred during the test series. The paper is a continuation of a previous paper "Electrical Insulation Qualification Test for TFTR TF and PF Coils", H. G. Johnson and R. J. Alton, 9th Symposium on Engineering Problems of Fusion Research, IEEE Publication No. 81CH1715-2.

8126 **Development of superconducting poloidal field coils for medium and large size tokamaks.** Dittrich, H.-G.; Forster, S.; Hofmann, A.; Jeske, U.; Katheder, H.; Khalil, A.; Krauth, H.; Lehmann, W.; Nick, W.; Nyilas, A. (Kernforschungszentrum Karlsruhe, Institut fur Technische Physik, Karlsruhe). pp 1350-1357 of Fusion engineering. Vol. 2. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Large long pulse tokamak fusion experiments require the use of superconducting poloidal field (PF) coils. In the past not much attention has been paid to the development of such coils. Therefore a development programme has been initiated recently at KfK. In this report start with summarizing the relevant PF coil parameters of some medium and large size tokamaks presently under construction or design, respectively. The most important areas of research and development work are deduced from these parameters. Design considerations and first experimental results concerning low loss conductors, cooling concepts and structural components are given.

8127 **Design and installation of instrumentation in the Westinghouse LCP coil.** Gaberson, P.C.; Singh, S.K. (Westinghouse Electric Corp., East Pittsburgh, PA). pp 280 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

This paper discusses the design and installation of instruments being built by Westinghouse for the Large Coil Program. The Westinghouse coil is a 37 ton superconducting device using

Nb_3Sn force-flow cooled conductors wound into aluminium structural plates. This coil, along with five similar coils being supplied by others, will be tested by Oak Ridge National Laboratory. The following instruments are being used in the Westinghouse coil: strain gages (60 structure mounted and 40 conductor mounted); platinum resistance thermometers (32 in structure and 8 in helium feed system); carbon glass resistance thermometers (4 on main leads, 4 on conductors, and 2 in helium feed system); Allen Bradley carbon resistors (4 on conductor); germanium resistance thermometers (4 on main leads and 2 in helium feed system); Hall generators (4 in bore of coil); magnetoresistance probes (4 in bore of coil); pickup coils (22 distributed around coil midplane); and voltage tap pairs (53 on conductor joints and 8 on heated turn). Discussion on each of these instruments includes selection criteria, mounting techniques, quality assurance considerations, and special design allowances made for their installation.

8128 **Dynamic control of the equilibrium field configuration in RFX.** Gnesotto, F.; Guarnieri, M.; Santagiustina, A. (Istituto Gas Ionizzati del CNR, Associazione EURATOM-CNR, Padova). pp 316-320 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The paper presents the main concepts which are at the basis of the active control design for the RFX poloidal field system. A computer model is then described, including plasma and electrical network dynamics, axisymmetric field calculation, and discontinuous shell effects. The shell is modelled by a simple lumped-parameter circuit whose currents coincide with the Fourier components of the toroidal current densities on the wall: the associated field distortions inside the vessel are then computed. The results of an open-loop analysis are presented for different programmed sets of control voltages. The power capabilities of the thyristor amplifiers in controlling the plasma position are finally discussed.

8129 **Calibrations of a tritium extraction facility.** Bretscher, M.M.; Farrar, H.; Oliver, B.M. (Argonne National Laboratory, Argonne, IL). pp 131-136 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

A tritium extraction facility has been built for the purpose of measuring the absolute tritium concentration in neutron-irradiated lithium metal samples. Two independent calibration procedures have been used to determine what fraction, if any, of tritium is lost during the extraction process. The first procedure compares independently measured ^4He, ^3He, and ^3H concentrations from the $^6Li(n, \alpha)T$ reaction. The second procedure compares measured $^6Li(n, \alpha)T/^{197}Au\ (n, \gamma)^{198}Au$ thermal neutron reaction rate ratios with those obtained from Monte Carlo calculations using well-known cross sections. Both calibration methods show that within the experimental error (about 1.5%) no tritium is lost during the extraction process.

8130 **JT-60 neutral beam injection system.** Shibata, T.; Akiba, M.; Araki, M.; Horrike, H.; Itoh, T.; Kitamura, S.; Kuriyama, M.; Matsuda, M.; Mizuhashi, K.; Ohara, Y. (Japan Atomic Energy Research Inst.). pp 2031-2035 of Fusion engineering. Vol. 2. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Construction of the neutral beam injection (NBI) system for the JT-60 was started in autumn of 1983. The NBI system must produce 20 MW of neutral beam power at energies of 75-100 keV for 10 sec. The system consists of 14 beamline units, a power supply system, a cryogenic system, a cooling system, an auxiliary pumping system and a control system. Each beamline unit is essentially the same as that of the prototype injector unit, which was constructed to confirm individual beamline performance. The power supply system consists of 14 units, each having a maximum rating of 100 kV, 80 A. The cryopumps are connected to a 2400 W helium refrigerator. Each beamline can be operated independently by the NBI computer system. From April 1984, each beamline will be tested at the prototype injector facility. All beamlines, after testing, will be installed on JT-60 starting in July 1985, with completion of the total system scheduled for July 1986.

8131 **6D02 Commissioning and initial operation of TFTR.** Sinnis, J. (Princeton Plasma Physics Lab., Princeton, NJ). pp 2096 of Fusion engineering. Vol. 2. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The TFTR (Tokamak Fusion Test Reactor) has as its primary objective the demonstration of energy breakeven (Q about 1). This will be accomplished by injecting energetic (120 keV) beams of deuterium atoms into a tritium plasma. This paper describes the subsystem tests and the integrated systems test program carried out during the final assembly phase of the TFTR construction project and the initial or ohmic heating phase of experimental operation. Discharge currents of 1 MA for durations in excess of one second have been achieved. These plasmas have been diagnosed by X-ray pulse height analysis and electron cyclotron emission to determine T/sub e/ 1 mm microwave interferometry to measure $\int$ n/sub e/ dl, and charge exchange energy analysis and D-D neutron counting to determine T/sub i/. Typical plasm parameters for these discharges are T/sub e/ about 1.5 keV, T/sub i/ about 1.4 keV and n/sub e/ about 2.5 x 10^{13} cm^{-3} with a Z/sub eff/ in the range to 3 to 4. This data, together with measured input power (plasma current and voltage), are put into a transport code which calculates (among other parameters), the energy confinement time, /tau/ /sub E/ for these discharges shows good agreement with Pfeiffer-Waltz (neo Alcator) scaling and reached a value of over 150 msec.

8132 **Doublet III neutral beam computer system overview and upgrade.** Glad, A.S.; Campbell, C.L.; Garcia, J.R.; Kamperschroer, J.H.; Lertique, P.; McColl, D.B.; Tooker, J.F. (GA Technologies Inc. San Diego, CA). pp 312-315 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Three neutral beamline injectors each containing two ion sources are currently operational on GA Technologies Doublet III tokamak experiment. A separate computer system is implemented for each beamline and provides acquisition, processing and archiving for all beamline and physics data and provides realtime control and automatic sequencing for all modes of operation. The computer system was developed and implemented from three separate software packages. The first, the data acquisition and processing of beamline physics data was built by the University of California Lawrence Berkeley Laboratories (LBL). The second, the real time control and automatic sequencing is an adapted version of the Doublet III control system. The third system, the archiving of all beamline data was developed from the archiving scheme used on the Doublet III diagnostic system. In this study, the current configurations of the beamline computer systems are described. It provides an insight into the future enhancements for improving the operational capabilities of the beamlines.

8133 **Doublet III neutral beam multi-stream command language system.** Campbell, L.; Garcia, J.R. (GA Technologies Inc., San Diego, CA). pp 309-311 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

A multi-stream command language system was developed to provide control of the dual source neutral beam injectors on the Doublet III experiment at GA Technologies Inc. The Neutral Beam command language system consists of three parts: compiler, sequencer, and interactive task. The command language, which was derived from the Doublet III tokamak command language, POPS, is compiled, using a recursive descent compiler, into reverse polish notation instructions which then can be executed by the sequencer task. The interactive task accepts operator commands via a keyboard. The interactive task directs the operation of three input streams, creating commands which are then executed by the sequencer. The streams correspond to the two sources within a Doublet III neutral beam, plus an interactive stream. The sequencer

multiplexes the execution of instructions from these three streams. The instructions include reads and writes to an operator terminal, arithmetic computations, intrinsic functions such as CAMAC input and output, and logical instructions. The neutral beam command language system was implemented using Modular Computer Systems (ModComp) Pascal and consists of two tasks running on a ModComp Classic IV computer. The two tasks, the interactive and the sequencer, run independently and communicate using shared memory regions. The compiler runs as an overlay to the interactive task when so directed by operator commands. The system is succesfully being used to operate the three neutral beams on Doublet III.

8134 **Issues in radioactivity for fusion energy: Remote Maintenance Rating.** Dorn, D.W.; Maninger, R.C. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1267-1273 of Fusion engineering. Vol. 2. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

We propose the Remote Maintenance Rating (RMR) as a numerical means of comparing materials and machine designs with respect to occupational exposures. The RMR is defined as the dose rate at the surface of a uniformly activated, thick, infinite slab with the same composition and density as the machine component. Based on current Nuclear Regulatory Commission (NRC) regulations, if the RMR is less than or equal to 2.5 mR/hr, the unprotected radiation worker can have unrestricted access to the component. If it is greater than 2.5 mR/hr, either the worker must spend only a limited time in contact with the component or special shielding and remote handling must be provided. The amount of special shielding required is proportional to the value of the RMR. They also use the RMR rating system to evaluate the suitability of several different iron-based alloys. The specific fusion power system design used in our evaluation was a conceptual design from the Mirror Advanced Reactor Study (MARS), a research project undertaken jointly by Lawrence Livermore National Laboratory, the University of Wisconsin, and TRW, Inc. plus several subcontractors. Based on these results, we determined that HT-9 is significantly better in terms of radiological dose rates at early times than the other iron-based alloys (by a factor of 3 to 7). We also calculated the behavior of both silicon carbide (SiC) and aluminum (Al), two "low activation" materials often proposed for reactors. Although SiC offers improvements over HT-9 by factors of from 1200 to 18,000, its RMR indicates that, because of the inevitable impurities, remote handling and maintenance techniques will be required for all machine components in the high neutron-flux regions of a fusion power system. Lowactivation aluminum may find application in low flux regions where its mechanical strength can be accommodated.

8135 **Tritium control and activation in the Pulse Star reactor.** Blink, J.A.; Hoffman, N.J. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 153-162 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Pulse Star is an inertial fusion reactor that uses LiPb coolant in a pool type geometry. LiPb does not release great quantities of chemical energy in a fire, and the pool geometry reduces the difficulty of safely transporting the extremely dense fluid. The compact geometry and good neutronics qualities of LiPb lead to a thermal-to-fusion energy ratio of 1.26, a tritium breeding ratio of 1.22, and a net electric power density 29 times higher than in a fission reactor containment building. The afterheat of the coolant and steel is low enough that emergency cooling systems will be either simple or not required. The gamma dose rate of the bell jar or screen is high enough to require remote maintenance of these components. The steam generators and pumps are on the borderline between limited handson and remote maintenance. With additional design attention, limited hands-on maintenance could be feasible for these components. The biological hazard potential indicates that only 10^{-7}-10^{-6} of the reactor central region can be vaporized and released; these are values typical of other fusion reactor designs. If the entire reactor is buried as a unit, shallow-land-burial will be legal with only minimal dilution. However, if the steel is disposed of separately, either the ^{94}Nb must be removed, or the 10CFR61 limit on ^{94}Nb must be relaxed. Tritium will be recovered through the reactor vacuum system, and leakage into the steam generator is <3% if no tritium barriers are used. Vacuum pumping considerations require the reactor pressure to be above about 10^{-3} torr (3×10^{-4} torr of tritium). Potential tritium releases from LiPb spills encourages us to reduce the upper bound on reactor pressure from the about 10^{-1} torr set by laser propagation to about 5×10^{-3} torr. If the entire LiPb inventory was spilled and exposed to the open atmosphere, 10-20 g of tritium is the maximum release. Smaller spills reduce the potential release to even lower levels.

8136 **Eddy current testing of the TFTR vacuum vessel bellows.** Rappe, G.H.; Sulish, F.J. (Princeton Plasma Physics Laboratory, Princeton, NJ). pp 127-130 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The functional requirements of the TFTR Vacuum Vessel are to provide the environment necessary to contain a plasma. This vacuum vessel is of modular construction, consisting of ten segments with various rigid sectors interspaced by fourteen bellows. The rigid sectors are manufactured from stainless steel plate, type 304 LN and the bellows are rolled from Inconel sheet type 625. During assembly the bellows are butt welded to the rigid sectors via a transition piece of Nitronix 33.

8137 **Design lessons from using programmable controllers in the MFTF-B Personnel Safety and Interlocks System.** Branum, J.D. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 287-290 of Fusion engineering. Vol. 1. New York, NY; IEEE (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Applying programmable controllers in critical applications such as personnel safety and interlocks systems requires special considerations in the design of both hardware and software. All modern programmable controller systems feature extensive internal diagnostic capabilities to protect against problems such as program memory errors; however most, if not all present designs lack an intrinsic capability for detecting and countering failures on the "field-side" of their I/O modules. Many of the most common styles of I/O modules can also introduce potentially dangerous sneak circuits, even without component failure. This paper presents the most significant lessons learned to date in the design of the MFTF-B Personnel Safety and Interlocks System, which utilizes two non-redundant programmable controllers with over 800 I/O points each. Specific problems recognized during the design process as well as those discovered during initial testing and operation are discussed along with their specific solutions in hardware and software.

99 GENERAL AND MISCELLANEOUS

8138 **(DOE/MA/00194—1) Report on 1985 national survey of compensation paid scientists and engineers engaged in research and development activities.** (Battelle Columbus Labs., OH (USA)). Nov 1985. Contract AC02-85MA00194. 352p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE86004364.

In November of 1966, the US DOE awarded a contract to the Columbus Division of Battelle to design a survey of compensation paid to scientific and engineering personnel engaged in research and development in the United States. The contract provided that such a survey would utilize the maturity or "age-wage" approach, under which salary data would be related to years since receipt of degree or chronological age. This document reports the results of the seventeenth annual survey, with a salary effective date of February 1, 1985.

8139 **(SAND—85-0749) Penetration of seafloor-rock anchors.** Forrestal, M.J. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1985. Contract AC04-76DP00789. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004226.

The author developed closed-form equations for forces on gun-launched, seafloor-rock anchors. Triaxial-test data guided the seafloor-rock, constitutive relationships that consisted of a linear hydrostat and a Mohr-Coulomb failure-criterion with a tension cutoff. Predictions from models were in reasonable agreement with penetration depths measured in field tests for sandstone and basalt seafloors.

9901 MANAGEMENT

REFER ALSO TO CITATION(S) 7709

8140 **(DOE/IG—0008/9) Office of Inspector General FY 1985-II semiannual report (April 1, 1985 to September 30, 1985).** Richards, J.R. (USDOE Office of Inspector General, Washington, DC). 30 Nov 1985. 49p. TIC, PO Bx 62, Oak Ridge, TN 37831. File Number TI86003937.

During this period, the Office of Audits issued 128 reports. Two reports concerned issues of a Department-wide nature and the recommendations were addressed to members of the Department's Senior staff. There were 28 other audit reports covering topics relating to specific facilities or operations which were addressed to the responsible field managers. The remaining 98 reports pertained to individual contractors and grantees receiving Departmental funds, and the reports were directed to the appropriate contracting officer.

8141 **(DOE/MA—0008/17) Department of Energy Audit Followup and Internal Control Review Tracking Systems quarterly management report as of June 30, 1985.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of the Controller). Aug 1985. 23p. NTIS, PC A02/MF A01. File Number DE85017502.

This cost provides information to Department of Energy (DOE) management on the status of audit followup and internal control review activities. It is based on data accumulated in accordance with draft DOE Order 2300.1A which established the DOE Audit Report Tracking System (DARTS), and the DOE Internal Control Tracking System (DICTS) which is described in draft DOE Order 1000.3A. These tracking systems are required by Office of Management and Budget Circulars A-50, "Audit Followup," and A-123, "Internal Control Systems," DOE Order 2300.1A further provides for bringing to the attention of the DOE Internal Control and Audit Review Council (DICARC) such matters as corrective actions inordinately delayed and unresolved disagreements between audit and action offices.

8142 **(ORNL—6153) Chemical Technology Division progress report, April 1, 1983-March 31, 1985.** (Oak Ridge National Lab., TN (USA)). Oct 1985. Contract AC05-84OR21400. 219p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86001429.

The status of the following programs is reported: fission energy; nuclear and chemical waste management; environmental control technology; basic science and technology; biotechnology programs; transuranium-element processing; Nuclear Regulatory Commission programs; Consolidated Edison Uranium Solidification Project; radioactive materials production; computer 1 engineering applications; and miscellanous programs.

8143 **(UCID—20445) Stability and strategic force modernization.** Reinhardt, G.C. (Lawrence Livermore National Lab., CA (USA)). 9 Jul 1985. Contract W-7405-ENG-48. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86003903.

We performed a number of exchange runs simulating the deployment of new strategic systems - the MX missile, the B-1 bomber (B-1B), and the Midgetman missile - to see how much force modernization improves the position of the US vis-a-vis the USSR and to examine its effects on stability. With each simulation, we found that force modernization did not improve crisis stability but did improve the outcome for the US, from the US point of view. However, we also discovered that if the B-1B were deployed with a robust and survivable ICBM force, stability would be noticeably improved because most of the incentive for a Soviet first strike would be removed. 4 refs., 23 tabs.

8144 **(UCID—20590) Crisis stability during a transition to a deterrence posture reliant on defenses.** Chrzanowski, P.L. (Lawrence Livermore National Lab., CA (USA)). 31 Oct 1985. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003904.

Issues about the crisis stability during the transition from the present offensive weapon dominated world to one where deterrence is based on competent defenses are discussed. A simple model of a nuclear exchange is introduced and used to highlight the importance making offensive forces survivable before the deployment of wide area defenses. A simple rule is suggested how to build-up area defenses so as to prevent dominance by either side and incentives to strike first in the event of the crisis. 1 ref., 12 figs.

8145 **(UCRL—92676-Rev.1) Status of the DOE cost estimating network. Revision 1.** Ker, K.R.; Hampel, V.E. (Lawrence Livermore National Lab., CA (USA)). Jul 1985. Contract W-7405-ENG-48. 16p. (CONF-8505212—1-Rev.1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002375.

From Annual Department of Energy (DOE) cost estimating meeting; New Orleans, LA, USA (15 May 1985).

We have made substantial improvements to the reliability of system performance and communications for the Department of Energy (DOE) cost estimating network. This network, also referred to as the DOE Cost Estimating System (CES), makes use of the Intelligent Gateway Processor (IGP) for automated access to eight cost estimating models maintained at different national laboratories and in industry: DODGE, FAST, DRI, LANL, DODGE SYS-1, CACES, UFD, and PDQ$. Authorized users need simply specify the command "connect" followed by the model name. The IGP then selects the most cost-effective path to the target computer anywhere in the country and activates the requested model for ready use. A menu-driven input procedure installed on the IGP permits those less familiar with computer operations to work effectively. To improve performance, we established on the PDP-11/70 a production environment by transferring software developers to the VAX-11/780, also on the TIS Local Area Network (LAN). In addition, we doubled the main memory to 4 Mbytes and installed new System Industries disk drives and a second controller. To improve reliable communications, we installed a data switch between the computer and our Tymnet engine and telephone lines. An extended on-line directory and news update feature are now operational. These short-term measures improved the overall reliability and response of the IGP Gateway.

8146 **(UCRL—93393) Lifelong engineering career is the goal.** Hesla, J.R.; Kaminski-da Roza, V. (Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 8p. (CONF-8510213—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002853.

From IEEE careers conference; Boston, MA, USA (3 Oct 1985).

LLNL actively seeks to provide a nurturing climate to support lifelong engineering careers. Through the Human Resources Department, the Laboratory has created a career development program by which individuals, at points along their growth path, can stop, review and evaluate their lives and careers.

9902 MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 7012, 7043, 7382, 7386, 7387, 7613, 7614, 7683, 7938

8147 **(ANL/MCS-TM—55) Implementing dense linear algebra algorithms using multitasking on the CRAY X-MP-4 (or approaching the gigaflop).** Dongarra, J.J.; Hewitt, T. (Argonne National Lab., IL (USA)). Aug 1985. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004093.

This note describes some experiments on simple, dense linear algebra algorithms. These experiments show that the CRAY X-MP

is capable of small-grain multitasking arising from standard implementations of LU and Cholesky decomposition. The implementation described here provides the "fastest" execution rate for LU decomposition, 718 MFLOPS for a matrix of order 1000.

8148 **(ANL/MCS-TM—58) Comments on the solution of sparse linear equations.** Duff, I.S. (Argonne National Lab., IL (USA)). Sep 1985. Contract W-31-109-ENG-38. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003984.

We consider primarily direct methods for the solution of sparse linear equations. We first illustrate the wide range of sparse matrix types that arise in different application areas. It is clear that methods taking advantage of a particular structure should do better than a general technique designed for all classes of sparse matrices. We comment on this both philosophically and empirically. We discuss the techniques used in general solution schemes and those used in particular applications - for example, the solution of equations resulting from discretizations of partial differential equations. We also consider the use of direct methods as a preconditioning to iterative methods for solution. We look at work in combinatorial algorithms that relates to the solution of sparse equations and comment on some of the open problems in this and other areas. Throughout we comment on available software and the relative performance of the methods as implemented in those software packages.

8149 **(ANL/TM—428) Plan for administrative computing at ANL FY1986 through FY1988.** Bretscher, M.; Hale, D.O.; Hischier, B.; Moore, N.; Moszur, F. (Argonne National Lab., IL (USA)). Jul 1985. Contract W-31-109-ENG-38. 320p. NTIS, PC A14/MF A01; GPO Dep. File Number DE85018559.

The introduction of the FY1986 through FY1988 Long-Range Plan assesses the state of administrative computing at ANL and the implications of FY1986 funding recommendations, which will affect the direction in which administrative computing will move at ANL. This document includes the strategy and goals which are an important part of the administrative planning for the Laboratory. The management guidelines established by the Administrative Data Processing Oversight Committee for the proposal and implementation of administrative computing systems are stated. The guidelines are a valuable tool for management in determining what applications would be appropriate to their needs and in formulating the proposals for those applications. The staff and facilities available within Computing Services at Argonne National Laboratory to assist administrative staff in acquiring the knowledge necessary to establish divisional or Laboratory-wide computing requirements are described. The various sections of Computing Services offer information for and assistance in the decision-making process. Summaries of the proposals for new or enhanced administrative computing systems presented by the Information Systems Section of Computing Services to the Administrative Data Processing Oversight Committee indicate some of the possibilities for future development of administrative computing systems at ANL. Although the areas of the various proposals are diverse, they share a common concern with the integration and unification of existing systems into a more efficient and productive whole. Detailed tables are presented to give information on how much the resources to develop and implement a given system will cost its users. The tables include development costs, computing/operations costs, software and hardware costs, and effort costs. They include both systems funded by Laboratory General Expense and systems funded by users themselves.

8150 **(BDX—613-3386) Keeping track of archived drawings: a case study.** Gault, B.C. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Oct 1985. Contract AC04-76DP00613. 21p. (CONF-8510207—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86003129.

From Applicon users group fall technical meeting; Boston, MA, USA (28 Oct 1985).

The Drafting Systems organization at Allied Corporation, Bendix Kansas City Division (BKC), is responsible for the creation of computer-readable media used for producing photoplots, phototools, and production traveler illustrations. From 1977 when the organization acquired its first Applicon system, until now, there have been over 50,000 different plots produced. Keeping track of what plot is on what archived tape has become a very tedious and time consuming task. This paper describes a software package using Datatrieve and TDMS running on a VAX 11/750 and how it has solved this problem.

8151 **(BDX—613-3387) VAX-based "IMAGE" backup.** Harris, D.D. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Oct 1985. Contract AC04-76DP00613. 16p. (CONF-8510207—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86003130.

From Applicon users group fall technical meeting; Boston, MA, USA (28 Oct 1985).

Increasing usage of the Applicon IMAGE systems at Bendix Kansas City Division (BKC) conflicts with the need to do daily backup of changed AGS files. This paper describes a VAX-based method for automated, unattended, off-shift backup.

8152 **(CONF-8506210—1) Abstract time-dependent transport equation.** Protopopescu, V. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002450.

From 1. workshop on operator theory and applications; Amsterdam, Netherlands (1 Jun 1985).

The abstract time-dependent transport equation is considered as an evolution (initial-boundary value) problem in the Banach spaces L/sub p/, $1 \leq p < \infty$. By using the trajectory method, the basic issues of existence, uniqueness, positivity, and dissipativity are settled for very general, possibly time-dependent domains, operators, and boundary conditions. 8 refs.

8153 **(LA—10522-MS) Comparison between the Wilson-Fowler Spline and the Circle Spline routines.** Dolin, R.M.; Oakes, W.R. (Los Alamos National Lab., NM (USA)). Nov 1985. Contract W-7405-ENG-36. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004367.

The Nuclear Weapons Complex has used the Wilson-Fowler Spline as its standard curve-fitting routine. This routine can be used effectively only in two dimensions since it requires an unacceptable amount of computer power to be adapted for use in three dimensions due mainly to the extra computations involved with an additional dimension. The Circle Spline routine can be used effectively in both two and three dimensions. Because a standard spline routine should possess the ability to work in two- and three-dimensional space, the Circle Spline routine was compared with the Wilson-Fowler routine to determine which procedure would better approximate a curve. In our experiments the Wilson-Fowler routine was generally smooth and had smaller errors; it handled reverse curvatures well. The Circle Spline had smaller errors at points of extreme curvature and compared favorably with the Wilson-Fowler Spline for most applications. 27 refs., 4 figs.

8154 **(LA-UR—85-3518) Alternatives to FORTRAN in control systems.** Howell, J.A.; Wright, R.M. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-8510194—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002390.

From 2. international workshop on accelerator control systems; Los Alamos, NM, USA (7 Oct 1985).

Control system software has traditionally been written in assembly language, FORTRAN, or Basic. Today there exist several high-level languages with features that make them convenient and effective in control systems. These features include bit manipulation, user-defined data types, character manipulation, and high-level logical operations. Some of theses languages are quite different from FORTRAN and yet are easy to read and use. We discuss several languages, their features that make them convenient for control systems, and give examples of their use. We focus particular attention on the language C, developed by Bell Laboratories.

8155 **(LA-UR—85-3597) Chaotic iteration and parallel divergence.** Wienke, B.R.; Hiromoto, R.E. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-8509200—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002420.

From Parallel computing conference; West Berlin, F.R. Germany (23 Sep 1985).

Parallelization of standard multigroup methods used to solve the linear (Boltzmann) transport equation in the discrete ordinates (S/sub n/) representation, coupled chaotic iteration scheme, and convergence are the focus of this analysis. On the Denelcor HEP, we investigate the parallel extension of two serial iteration schemes, categorize speedup, and perform some numerical experiments in chaotic iteration.

8156 **(LBL—20084) Outline of a failure: a true story of nine precepts, with two morals.** Stevens, D.F. (Lawrence Berkeley Lab., CA (USA)). Aug 1985. Contract AC03-76SF00098. 7p. (CONF-860924—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86000601.

From 10. world computer congress; Dublin, Ireland (1 Sep 1986).

This is not a conventional case history. It is concerned with failure rather than with triumph, and further, with a personal definition of failure. Failure, like beauty, is in the eye of the beholder. The system I shall call SOS, when measured in terms of absolute achievement, might not be considered a failure. When measured against corporate plans and goals it might not be admitted to be a failure. But when measured against some aspects of the state-of-the-art it professed to advance, against fundamental ergonomic principles, and, especially, against its potential, it was a failure. Specifically, it failed to meet the expectations of one user. It is only fair, then, to begin by characterizing those expectations and giving some indication of their sources. Then follow five sections on various classes of failure. (The Precepts of the title are embedded in these sections.) The paper concludes with a brief discussion of the Two Morals.

8157 **(N—85-10378) The FLEX/32 multicomputing environment.** Matelan, N. (National Aeronautics and Space Administration, Langley AFB, VA (USA). Langley Research Center). Oct 1984. vp. NTIS, PC A18/MF A01.

In NASA. Langley Research Center Res. in Struct. and Dyn., 1984 Oct. 1984 p 1-14 ref.; for primary document see N85-11377 01-39.

The FLEX/32 Multicomputer is a generic environment for cooperating multiple processors. The FLEX/32 supports a number of different processors, making it heterogeneous in terms of the instruction sets it supports, and homogeneous in its ability to provide consistent storage and input/output facilities to its differing processors. These facilities are accessed through standard 32-bit VMEbus connections. The FLEX/32 supports the full UNIX System V Operating System and languages associated with it, plus the extended ConCurrent C and Concurrent FORTRAN 77 languages that allow programming of concurrent software at a high level. Direct programming support at all levels is provided by the environment hardware for concurrent software execution and optimization, including hardware support for shared resource access arbitration, conditional critical region arbitration, and interprocessor messages.

8158 **(PNL-SA—13252) Evaluation of graphical techniques for data in dimensions 3 to 5: scatter plot matrix, glyph and stereo examples.** Carr, D.B.; Nicholson, W.L. (Pacific Northwest Labs., Richland, WA (USA)). 1985. Contract AC06-76RL01830. 8p. (CONF-8508115—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86004021.

From American Statistical Association for joint statistical meetings; Las Vegas, NV, USA (5 Aug 1985).

Numerous methods are available for displaying data in dimensions three through five. While results concerning elementary perceptual tasks are applicable, they do not necessarily indicate the strengths and weaknesses of the display methods for higher-order tasks such as looking for functional form, density patterns (including symmetry and independence), outliers, and local dimensionality. This paper suggests that guidance concerning preferred display techniques can be developed. The approach suggested is the subjective evaluation of graphical techniques as applied to constructed data sets. Constructed data sets serve as informative reference examples, or counter examples, for evaluating the effectiveness of particular techniques. For illustration, several display techniques are applied to a mystery data set with the expressed goal of looking for functional form. Some techniques do not perform well for this example.

8159 **(SAND—85-0315) ARIES data structure file.** Sears, M.P. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85014341.

This paper describes version 2.0 of the ARIES data structure (ADS) file, and the subroutines used to access it. ADS files are very flexible neutral files which can be used in almost any finite element or finite difference data management application, including initial problem setup, cycle restart dumps, history and plot output, and even for internal data management. The ADS subroutine package is written in RATFOR, a pre-processed version of FORTRAN-77. The ADS files are hierarchically organized and may be accessed randomly, and the package supports multiple files.

8160 **(SAND—85-2035) CONFIG8: a configuration file generator for SANDIA TASK8.** Chambers, W.F. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1985. Contract AC04-76DP00789. 58p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86003189.

CONFIG8 is a Flextran program that is used for defining the configuration of a microprobe that uses SANDIA TASK8. CONFIG8 creates a data file that is read by TASK8 to determine both the options available and the specific configuration of the instrument. This file also initializes various TASK8 defaults; specifies deadtimes, crystal assignments, and, where possible, beam currents available; and defines special stage positions. CONFIG8 can be used either as a stand-alone program or as an auxiliary program imbedded in TASK8. After SANDIA TASK has been in use, CONFIG8 can be used to indicate changes in configuration or to redefine or adjust the default values of constants used by TASK8. Since TASK8 can specify which configuration file to use, different operators of a given instrument can create configuration files tailored to their individual needs. The various CONFIG8 commands are described, the meaning of each of the configuration variables is given, and sample summaries and commented program listings are provided.

8161 **(SAND—85-2037) SANDIA TASK8: a subroutined electron microprobe automation system.** Chambers, W.F. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1985. Contract AC04-76DP00789. 124p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86003791.

TASK8 is a Flextran program designed to provide instrument control, data acquisition, and data reduction for electron microprobes and scanning electron microscopes equipped with up to seven wavelength-dispersive spectrometers and up to four stage motions (X, Y, Z, and rotation). Instrument control and data acquisition are achieved through a group of mnemonic commands which can be combined into storable subroutines to provide automatic control. TASK8 also acts as a host program for specialized auxiliary routines which are automatically called as a particular command needs them. Through the use of this technique, it is possible to perform an entire quantitative analysis by issuing the command QUANT and answering the few questions which follow. SANDIA TASK8 is a systems approach to microprobe automation. Since the majority of the code is in subroutines which are stored in virtual memory, its expansion capabilities are limited by the user's imagination rather than the memory of the machine. The program set currently encompasses TASK8, the master program with its subroutines for machine control nd data collection and analysis; CONFIG8, a program for defining instrument operating conditions; and various quantitative analysis programs with their subroutines. Bence-Albee, ZAF, and phi(rhoZ) quantitative techniques are supported. Up to 50 oxides may be analyzed by Bence-Albee or 30 elements by the other techniques. Of special interest to geologists are the abilities to automatically perform end-member calculations and to perform a quantitative analysis by specifying its mineral code. The SANDIA TASK8 software system is now being used on

Cameca MBX microprobes with 2, 3, and 4 spectrometers, on 3, 4, and 5-spectrometer JEOL-733's and on a 5-spectrometer ARL-SEMQ.

8162 **(SAND—85-2297) Monitoring stability when solving ODEs numerically.** Shampine, L.F. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1985. Contract AC04-76DP00789. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003796.

A simple and inexpensive way to monitor the stability of the common numerical schemes for the solution of the initial value problem for a system of ordinary differential equations (ODEs) is proposed. An important application to the solution of stiff problems by extrapolation of a semi-implicit midpoint rule is made. 8 refs.

8163 **(UCID—20555) Secure user authentication in a distributed computing environment.** Aiken, D. (Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86002960.

This is a description of a user authentication system for a distributed computing environment. The basis of this system is a secure communication path where the information exchanged is protected from release, modification and replay. The distributed computing environment refers to a collection of independently administered networks, connected by gateways, with varying levels of trust between the networks.

8164 **(UCRL—92925) Design guidelines for the use of audio cues in computer interfaces.** Sumikawa, D.A.; Blattner, M.M.; Joy, K.I.; Greenberg, R.M. (Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA)). 01 Jul 1985. Contract W-7405-ENG-48. 25p. (CONF-860107—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85015176.

From 19. annual Hawaii international conference on system sciences; Honolulu, HI, USA (8 Jan 1986).

A logical next step in the evolution of the computer-user interface is the incorporation of sound thereby using our senses of "hearing" in our communication with the computer. This allows our visual and auditory capacities to work in unison leading to a more effective and efficient interpretation of information received from the computer than by sight alone. In this paper we examine earcons, which are audio cues, used in the computer-user interface to provide information and feedback to the user about computer entities (these include messages and functions, as well as states and labels). The material in this paper is part of a larger study that recommends guidelines for the design and use of audio cues in the computer-user interface. The complete work examines the disciplines of music, psychology, communication theory, advertising, and psychoacoustics to discover how sound is utilized and analyzed in those areas. The resulting information is organized according to the theory of semiotics, the theory of signs, into the syntax, semantics, and pragmatics of communication by sound. Here we present design guidelines for the syntax of earcons. Earcons are constructed from motives, short sequences of notes with a specific rhythm and pitch, embellished by timbre, dynamics, and register. Compound earcons and family earcons are introduced. These are related motives that serve to identify a family of related cues. Examples of earcons are given.

8165 **(UCRL—93564) New ideas for parallel algorithms on vector- and multi-processors.** Reiter, E.; Rodrigue, G.; Wolitzer, D. (California State Univ., Hayward (USA); Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 17p. (CONF-8509200—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86002989.

From Parallel computing conference; West Berlin, F.R. Germany (23 Sep 1985).

Parallel numerical algorithms are characterized by having within their overall mathematical structure certain well-defined substructures that can be executed simultaneously. These mathematical substructures can be individual arithmetic operations such as the addition of two vectors, or mathematical tasks such as the inversion of sequence of matrices. Computers vary on how they carry out these mathematical substructures; however, over the past decade two distinct computer architectural trends have become popular: the vector processor and the multi-processor. Vector processors can execute parallel mathematical tasks at the floating point operation level. Even more specifically, they can only execute identical floating point operations. Multiprocessors, on the other hand, can execute larger mathematical subtasks. In this article, we review the basic features of the vector- and multi-processor and then demonstrate some new ideas on how parallel mathematical substructures can be produced so as to create efficient algorithms for these machines. Computational examples will be given in both cases. 8 refs., 3 figs.

9903 INFORMATION HANDLING

8166 **Data base for solvent extraction chemistry.** McDowell, W.J.; Michelson, D.C.; Moyer, B.A.; Coleman, C.F. (Oak Ridge National Lab., TN). *Physical Chemistry (General);* 257-258([1985]). Contract W-7405-ENG-26.

The rapid proliferation of scientific and science-related literature has made information retrieval a real problem in most scientific disciplines, but in many respects the problem is more serious in separations science than in other areas. This arises from the fact that extraction, ion exchange, and chromatographic separations are used in many different disciplines, and the same operations have acquired different names in these different disciplines. Also, different operations are sometimes referred to by the same name. Reports of many government laboratories in the period 1945 to 1967 are poorly indexed and are now difficult or impossible to find. These reports are being included in the data base described here. In an effort to alleviate many of the above-mentioned problems, an attempt is being made to assemble a computer-searchable data base, called "Separations Science Data Base," that is designed specifically for retrieval of information needed in chemical separations problems. The initial aim of this data base is to emphasize solvent extraction and ion exchange literature, although the indexing is structured so as to include other separations methods such as distillation, precipitation, or flotation, for example. The data base is supported by the Oak Ridge National Laboratory computer system by a data management and retrival system called RECON (REmote CONsole), and the reference material can be retrieved in an interactive manner not only in terms of author, title, source, and date of publication entries but also in terms of the substance separated (both those recovered and those rejected), the separation agent used, the matrix from which the separation is made, and the type of information contained in the reference.

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Each entry under a corporate heading gives the document title and the volume and abstract numbers. The document type, e.g., R for Report; country of publication, e.g., US; and language of the document, e.g., In German, are given in parentheses at the end of the entry. If no language statement appears, the language is English. Tables of document types and country of publication codes appear after the indexes.

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The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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AC06-77RL01030	**Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations**	
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AC07-76ID01570	**EG and G Idaho, Inc., Idaho Falls (USA)**	
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AC07-79ID12079	**Utah Univ. Research Inst., Salt Lake City (USA). Earth Sciences Lab.**	
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AC08-76NV00020	**Holmes and Narver, Inc., Las Vegas, NV (USA). Energy Support Div.**	
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AC08-82NV10250	**Westinghouse Electric Corp., Mercury, NV (USA). Waste Technology Services Div.**	
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AC08-83NV10282	**Martin Marietta Energy Systems, Oak Ridge, TN (USA)**	
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AC09-76SR00001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
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AC21-79MC12010	Maryland Univ., College Park (USA). Photomechanics Lab.	
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AC22-81PC40009	Amoco Research Center, Naperville, IL (USA)	
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AC22-83PC60408	Viking Energy Corp., Pittsburgh, PA (USA)	
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AC22-83PC63032	TRW Space and Technology Group, Redondo Beach, CA (USA)	
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AC22-84PC72001	Kentucky Univ., Lexington (USA). Dept. of Mining Engineering	
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AC22-84PC72007	AMAX Extractive Research and Development, Inc., Golden, CO (USA)	
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AC22-84PC72008	TRW Space and Technology Group, Redondo Beach, CA (USA)	
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AC22-85PC80016	SRI International, Menlo Park, CA (USA)	
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AC22-85PC81008	Tennessee Univ., Tullahoma (USA). Space Inst.	
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AC79-83BP11902	IEC Beak Consultants Ltd., Richmond, British Columbia (Canada)	
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AC79-83BP13102	Buell and Associates, Inc., Beaverton, OR (USA)	
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AI01-77CS51040	Case Western Reserve Univ., Cleveland, OH (USA)	
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AI08-76DP00474	Geological Survey, Reston, VA (USA)	
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AI08-78ET44802	Geological Survey, Menlo Park, CA (USA)	
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AI79-81BP27780	National Marine Fisheries Service, Seattle, WA (USA). Coastal Zone and Estuarine Studies Div.	
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AI79-84BP12910	Oregon Dept. of Fish and Wildlife, Corvallis (USA)	
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AM03-76SF00167	General Atomic Co., San Diego, CA (USA)	
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AS03-80ER52062	California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering	
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AS05-76ER03948	Houston Univ., TX (USA). Dept. of Physics	
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AT03-77ER10008	Utah Univ., Salt Lake City (USA)	
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FG01-82CE15088	Khorsnad (Hossein), Eagle, ID (USA)	
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FG01-82CE15128	Ply International, Inc., Windom, TX (USA)	
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FG01-83FE60294	Southern States Energy Board, Atlanta, GA (USA)	
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FG01-84CE24443	Michigan State Univ., East Lansing (USA)	
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FG02-84ER45069	**Michigan Univ., Ann Arbor (USA). Dept. of Materials and Metallurgical Engineering**	
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FG02-84ER45076	**Department of Physics and Laboratory for Surface Studies, University of WisconsinMilwaukee, Milwauke**	
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FG02-84ER45132	**City Coll., New York (USA). Dept. of Physics**	
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FG02-84ER45158	**Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering**	
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FG02-85ER13352	**Nebraska Univ., Lincoln (USA)**	
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FG03-80R950006	**Micronesia Bound, Inc., Nett Point, Aramas Kapw, HI (USA)**	
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FG03-83SF11947	**American Solar Energy Society, Boulder, CO**	
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FG03-84ER13251	**Department of Chemistry, Stanford University, Stanford, California 94305**	
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FG03-85SF15799	**Hawaii Univ., Honolulu (USA). Hawaii Natural Energy Inst.**	
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FG05-80EV10321	**Undersea Medical Society, Inc., Bethesda, MD (USA)**	
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FG05-83OR21390	**Forest Service, St. Paul, MN (USA). North Central Forest Experiment Station**	
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FG05-85ER13339	**Meharry Medical Coll., Nashville (USA). Dept. of Biochemistry**	
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FG06-80R000481	**Cascadian Farm, Rockport, WA (USA)**	
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FG06-80R000542	**Coastal Petroleum Associates, Baton Rouge, LA (USA)**	
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FG06-80R000608	**Fairbanks Grant, Hooper Bay, AK (USA)**	
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FG07-83ID12466	**Maine Dept. of Environmental Protection, Augusta (USA)**	
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FG09-85ER60311	**Skidaway Inst. of Oceanography, Savannah, GA (USA)**	
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FG22-81PC40789	**School of Mechanical Engineering, Purdue University, West Lafayette, Indiana 47907**	
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FG22-82PC50800	**Illinois Univ., Urbana (USA). Dept. of Chemistry**	
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FG22-82PC50804	**Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering**	
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FG22-83PC60039	**Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering**	
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FG22-84PC70770	**Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences**	
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FG22-84PC70795	**Tennessee Univ., Knoxville (USA). Dept. of Chemistry**	
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FG22-84PC79892	**Tuskegee Inst., AL (USA). Dept. of Chemical Engineering**	
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FG41-79R110027	**East Machias, Town of, ME (USA)**	
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FG41-79R110063	**Resource Recovery Systems, Inc., Branford, CT (USA)**	
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FG41-80R110392	**Saunders and Sons Enterprises, Westerly, RI (USA)**	
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FG42-79R205006	**Pietri (Jose M.), Yanco (Puerto Rico)**	
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FG47-77CS62029	**Nebraska Energy Office, Lincoln (USA)**	
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NAS-7-100-957175	**North Carolina State Univ., Raleigh (USA). Dept. of Materials Engineering**	
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CONF-8403146-	(IEA workshop on latent heat stores - technology and applications, Stuttgart, F.R. Germany, 7-9 Mar 1984)				
	See Juel-Spez-297		DE86750490	MN -94a	11:7317
CONF-8403207-	(9. international NEA/Seabed Working Group meeting, Berlin, F.R. Germany, 27-29 Mar 1984)				
	See SAND-84-1451	E 1.99:	DE85017595	MN -70	11:7023
CONF-840530-	(International symposium on in-beam nuclear spectroscopy, Debrecen, Hungary, 14-18 May 1984)				
11	*See* UCRL-90792	E 1.99:	DE86002619	MN -34C	11:8020
CONF-8405192-	(Workshop on instrumentation for the advanced high flux reactor, Oak Ridge, TN, USA, 30 May 1984)				
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85016150	MN -80	11:7236
CONF-8405226-	(Symposium on containment fluxes through the coastal zone, Nantes, France, 14-16 May 1984)				
2	*See* BNL-37114	E 1.99:	DE86002931	MN -11	11:7586
CONF-8406187-	(6. symposium on applied surface analysis, Dayton, OH, USA, 6-8 Jun 1984)				
3	*See* UCRL-90427	E 1.99:	DE86002626	MN -10	11:7464
CONF-840734-	(25. annual meeting of the Institute of Nuclear Materials Management, Columbus, OH, USA, 15-18 Jul 1984)				
	Nucl. Mater. Manage., 13: 207-211(Jul 1984)				11:7311
	Nucl. Mater. Manage., 13: 178-185(Jul 1984)				11:7770
	Nucl. Mater. Manage., 13: 212-215(Jul 1984)				11:7787
	Nucl. Mater. Manage., 13: 216-219(Jul 1984)				11:7788
CONF-840852-	(Fiber Fuels Institute summer trade show and technical conference, Superior, WI, USA, 7-10 Aug 1984)				
Pt.1	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE85008377	MN -61	11:7072
CONF-840905-	(Joint power generation conference, Toronto, Canada, 30 Sep-4 Oct 1984)				
	Am. Soc. Mech. Eng., [Pap.], No. 84-JPGC-GT-5, 10(Sep 1984)				11:7179
	Am. Soc. Mech. Eng., [Pap.], No. 84-JPGC-NE-5, vp(Sep 1984)				11:7213
	Am. Soc. Mech. Eng., [Pap.], No. 84-JPGC-NE-15, 7(Sep 1984)				11:7214
CONF-840937-	(Applied superconductivity conference, San Diego, CA, USA, 9-13 Sep 1984)				
	IEEE Trans. Magn., MAG 21: No. 2, 795-798(Mar 1985)				11:7185
	IEEE Trans. Magn., MAG 21: No. 2, 791-794(Mar 1985)				11:7186
	IEEE Trans. Magn., MAG 21: No. 2, 752-755(Mar 1985)				11:7315
	IEEE Trans. Magn., MAG 21: No. 2, 1122-1128(Mar 1985)				11:7640
	IEEE Trans. Magn., MAG 21: No. 2, 1115-1118(Mar 1985)				11:7641
	IEEE Trans. Magn., MAG 21: No. 2, 1071-1074(Mar 1985)				11:8112
	IEEE Trans. Magn., MAG 21: No. 2, 1060-1063(Mar 1985)				11:8113
	IEEE Trans. Magn., MAG 21: No. 2, 238-241(Mar 1985)				11:8114
	IEEE Trans. Magn., MAG 21: No. 2, 234-237(Mar 1985)				11:8115
	IEEE Trans. Magn., MAG 21: No. 2, 1091-1094(Mar 1985)				11:8116
	IEEE Trans. Magn., MAG 21: No. 2, 1087-1090(Mar 1985)				11:8117
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	IEEE Trans. Magn., MAG 21: No. 2, 1099-1102(Mar 1985)				11:8119
	IEEE Trans. Magn., MAG 21: No. 2, 1067-1070(Mar 1985)				11:8120
34	*See* CEA-CONF-7597		DE86750302	MN -38	11:7619
CONF-8409281-	(14. European solid state device research conference including solid state device technology, Lille, France, 10 Sep 1984)				
1	*See* CEA-CONF-7760		DE86750301	MN -25	11:7620

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CONF-841007-	(Nuclear science symposium, Orlando, FL, USA, 31 Oct-2 Nov 1984)			
	IEEE Trans. Nucl. Sci., NS-32: No. 1, 966-968(Feb 1985)			11:7768
	IEEE Trans. Nucl. Sci., NS-32: No. 1, 969-971(Feb 1985)			11:7769
	IEEE Trans. Nucl. Sci., NS-32: No. 1, 957-960(Feb 1985)			11:7826
	IEEE Trans. Nucl. Sci., NS-32: No. 1, 964-966(Feb 1985)			11:7827
CONF-8410103-	(Automotive technology development contractors' coordination meeting, Dearborn, MI, USA, 29 Oct-2 Nov 1984)			
11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86002248	MN -96	11:7485
CONF-8410112-	(Symposium on polymer research at synchrotron radiation sources, Upton, NY, USA, 29-31 Oct 1984)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86002206	MN -34	11:8042
CONF-8410168-	(6. Biennial computer use by engineers symposium (CUBE), Los Alamos, NM, USA, 10-12 Oct 1984)			
1	*See* UCRL-90983	E 1.99: DE86002193	MN -38	11:7681
CONF-8410173-	(International meeting on reduced enrichment for research and test reactors, Argonne, IL, USA, 14-18 Oct 1984)			
14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86002259	MN -80	11:7237
CONF-8410186-	(Symposium on optical materials for high power lasers, Boulder, CO, USA, 15-17 Oct 1984)			
5	*See* LA-UR-85-3734	E 1.99: DE86002443	MN -38	11:7647
CONF-8410256-	(Workshop on scientific opportunities with advanced facilities for neutron scattering, Shelter Island, NY, USA, 23-26 Oct 1984)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86002269	MN -34C	11:8043
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86002268	MN -80	11:7217
CONF-8410276-	(Boulder damage symposium, Boulder, CO, USA, 15-17 Oct 1984)			
4	*See* LA-UR-85-3864	E 1.99: DE86002422	MN -38	11:7650
CONF-8410349-	(International colloquium on SAID-SPWLA logs, Paris, France, 23-26 Oct 1984)			
2	*See* CEA-CONF-7484	DE86750305	MN -66a	11:7874
CONF-841157-	(Materials Research Society annual meeting, Boston, MA, USA, 26-29 Nov 1984)			
100	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86002192	MN -25	11:7507
CONF-8411100-	(International conference on applied lasers and electro optics, Boston, MA, USA, 12-15 Nov 1984)			
5	*See* UCRL-90805	E 1.99: DE86002601	MN -38	11:7653
CONF-8411153-	(International conference on lasers '84, San Francisco, CA, USA, 26-30 Nov 1984)			
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86003252	MN -34A	11:7910
CONF-8411220-	(Air Pollution Control Association, Houston, TX, USA, 29 Nov 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86002185	MN -11	11:7805
CONF-841210-	(International chemical congress of Pacific Basin Society, Honolulu, HI, USA, 16-21 Dec 1984)			
30	*See* UCRL-90712	E 1.99: DE86002625	MN -34C	11:7923
CONF-841218-	(31. national vacuum symposium, Reno, NV, USA, 3-7 Dec 1984)			
28	*See* UCRL-90938	E 1.99: DE86002621	MN -21	11:8106
CONF-841231-	(DOE/ORNL heat pump conference, Washington, DC, USA, 10-13 Dec 1984)			
	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99: DE86002984	MN -95d	11:7378
CONF-850103-	(2. symposium on space nuclear power systems, Albuquerque, NM, USA, 14-16 Jan 1985)			
13	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86003307	MN -94	11:7314
CONF-850152-	(3. LEAR workshop, Tignes-Savoie, France, 19-26 Jan 1985)			
5	*See* BNL-36635	E 1.99: DE85014219	MN -28	11:7941
CONF-850171-	(5. Moriond workshop on heavy quarks, flavor mixing and CP violation, La Plagne, France, 13-19 Jan 1985)			
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86003161	MN -34D	11:7948
CONF-850201-	(ASME energy-sources technology conference and exhibition, Dallas, TX, USA, 17-22 Feb 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86003817	MN -90c	11:6888
CONF-850206-	(International ANS/ENS topical meeting on probabilistic safety methods and applications, San Francisco, CA, USA, 24 Feb-1 Mar 1985)			
32	*See* EGG-M-17284	E 1.99: DE85016153	MN -80	11:7222
CONF-850242-	(7. symposium on management of uranium mill tailings, low-level waste and hazardous waste, Ft. Collins, CO, USA, 6-8 Feb 1985)			
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86003160	MN -70A	11:6974
CONF-850297-	(2. USAID/GOI workshop on alternative energy resources and development, New Delhi, India, 4-6 Feb 1985)			
	NTIS, PC A19; 3	DE85017291	MN -05	11:6886

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CONF-8503105-	(Orbital dynamics and applications to accelerators workshop, Berkeley, CA, USA, 7-12 Mar 1985)			
10	*See* LBL-19808	DE86002867	MN -28	11:7749
CONF-850476-	(Symposium on lasers and particle beams for fusion and strategic defense, Rochester, NY, USA, 18-19 Apr 1985)			
3	*See* LA-UR-85-3471	E 1.99: DE86002391	MN -38	11:7645
CONF-8504130-	(10. annual EPRI contractors' conference on coal liquefaction, Palo Alto, CA, USA, 23-25 Apr 1985)			
	See EPRI-AP-4253-SR	TI86920056	ND -90d	11:6904
CONF-8504135-	(15. international technical meeting on air pollution modeling and it's application, St. Louis, MO, USA, 15-19 Apr 1985)			
5	*See* GKSS-85/E/18	DE86900299	MN -11	11:7813
CONF-8504152-	(Workshop on experiments for Relativistic Heavy Ion Collider (RHIC), Upton, NY, USA, 15-19 Apr 1985)			
10	*See* BNL-37196	E 1.99: DE86002924	MN -34C	11:8030
11	*See* BNL-37189	E 1.99: DE86002925	MN -34D	11:7942
12	*See* BNL-37195	E 1.99: DE86003636	MN -28	11:7705
CONF-850504-	(Particle accelerator conference, Vancouver, Canada, 13-16 May 1985)			
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2596-2598(Oct 1985)			11:7690
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2593-2595(Oct 1985)			11:7691
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2605-2607(Oct 1985)			11:7692
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2171-2173(Oct 1985)			11:7693
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	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2632-2634(Oct 1985)			11:7701
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2196-2200(Oct 1985)			11:7702
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2201-2205(Oct 1985)			11:7703
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2174-2176(Oct 1985)			11:7715
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2144-2146(Oct 1985)			11:7716
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2602-2605(Oct 1985)			11:7717
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2177-2179(Oct 1985)			11:7718
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2147-2149(Oct 1985)			11:7719
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2626-2628(Oct 1985)			11:7720
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2635-2637(Oct 1985)			11:7721
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2104-2106(Oct 1985)			11:7722
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2107-2109(Oct 1985)			11:7723
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2110-2111(Oct 1985)			11:7724
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2112-2114(Oct 1985)			11:7725
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2115-2116(Oct 1985)			11:7726
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	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2123-2125(Oct 1985)			11:7728
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2126-2128(Oct 1985)			11:7729
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2129-2131(Oct 1985)			11:7730
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2117-2119(Oct 1985)			11:7731
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2132-2134(Oct 1985)			11:7732
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2141-2143(Oct 1985)			11:7733
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2150-2152(Oct 1985)			11:7734
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2162-2164(Oct 1985)			11:7735

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	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2165-2170(Oct 1985)			11:7736
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2180-2182(Oct 1985)			11:7737
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2206-2208(Oct 1985)			11:7738
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2662-2665(Oct 1985)			11:7739
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2669-2671(Oct 1985)			11:7740
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2675-2677(Oct 1985)			11:7741
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 1959-1960(Oct 1985)			11:7742
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2080-2082(Oct 1985)			11:7743
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2086-2088(Oct 1985)			11:7744
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	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2101-2103(Oct 1985)			11:7746
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2608-2610(Oct 1985)			11:7766
	IEEE Trans. Nucl. Sci., NS-32: No. 5, 2186-2190(Oct 1985)			11:7767
296	*See* UCRL-91956	E 1.99: DE86001651	MN -28	11:7698
CONF-8505211-	(Raymond and Beverly Sackler distinguished lectures, Tel Aviv, Israel, 5 May 1985)			
1	*See* LA-UR-85-3569	E 1.99: DE86002402	MN -34	11:8049
2	*See* LA-UR-85-3546	E 1.99: DE86002384	MN -34	11:8060
CONF-8505212-	(Annual Department of Energy (DOE) cost estimating meeting, New Orleans, LA, USA, 15-16 May 1985)			
1-Rev.1	*See* UCRL-92676-Rev.1	E 1.99: DE86002375	MN -13	11:8145
CONF-850602-	(16. international congress on combustion engines, Oslo, Norway, 3-7 Jun 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86003819	MN -90c	11:6890
CONF-850609-	(25. annual international conference of the Canadian Nuclear Association and 6. annual conference of the Canadian Nuclear Society, Ottawa, Ontario, Canada, 2-5 Jun 1985)			
2	*See* AECL-8851	TI86900294	ND -70B	11:6988
CONF-850610-	(Annual meeting of the American Nuclear Society, Boston, MA, USA, 9-14 Jun 1985)			
40	*See* PNL-SA-128195	E 1.99: DE85016271	MN -78	11:7195
46	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85016386	MN -78	11:7196
49	*See* PNL-SA-12814	TI85017897	MN -78	11:7296
52	*See* BNL-NUREG-36947	TI85018485	MN -80	11:7250
CONF-850670-	(ASME Pressure Vessel and Piping Division conference, New Orleans, LA, USA, 24-29 Jun 1985)			
27	*See* PNL-SA-13035	TI85018526	MN -78	11:7192
CONF-850679-	(18. American Society for Testing and Materials symposium, Boulder, CO, USA, 1 Jun 1985)			
3	*See* LBL-19828	E 1.99: DE86002877	MN -25	11:7451
CONF-8506100-	(3. IEEE conference on human factors and power plants, Monterey, CA, USA, 23-27 Jun 1985)			
6	*See* BNL-NUREG-36888	TI85018489	MN -78	11:7208
CONF-8506110-	(Review of progress in quantitative NDE, Williamsburg, VA, USA, 23-28 Jun 1985)			
6	*See* EGG-M-09385	E 1.99: DE86003230	MN -38	11:7669
CONF-8506114-	(International seminar on radioactive waste products suitability for final disposal, Julich, F.R. Germany, 10-13 Jun 1985)			
3	*See* AECL-8853	TI86900292	ND -70	11:6989
CONF-8506141-	(SDIO/DARPA annual propagation review, Monterey, CA, USA, 24-28 Jun 1985)			
14	*See* UCRL-92873	E 1.99: DE86002374	MN -28	11:7699
CONF-8506148-	(Workshop on requirements of mobile teleoperators for radiological emergency response and recovery, Dallas, TX, USA, 23-25 Jun 1985)			
5	*See* PNL-SA-13505	E 1.99: DE86004030	MN -41	11:7298
CONF-8506165-	(Workshop on the relation between mechanical properties and micro-structure under fusion irradiation conditions, Ebeltoft, Denmark, 27 Jun-2 Jul 1985)			
4	*See* HEDL-SA-3353	E 1.99: DE86004016	MN -80	11:7448
CONF-8506166-	(29. annual meeting American Association of Cost Engineers, Denver, CO, USA, 30 Jun-3 Jul 1985)			
1	*See* TVA/PE/OPS-84/6	DE85901742	MN -97	11:7355
CONF-8506173-	(Workshop on polarized beams at the SSC, Ann Arbor, MI, USA, 10-15 Jun 1985)			
4	*See* BNL-37129	E 1.99: DE86002507	MN -34D	11:7978

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CONF-8506191-	(Workshop on effects of natural organic compounds and of microorganisms and radionuclide transport, Paris, France, 11 Jun 1985)				
2	*See* BNL-37206	E 1.99:	DE86003631	MN -11	11:7836
CONF-8506194-	(International symposium on multiparticle dynamics, Kiryat Anavim, Israel, 1 Jun 1985)				
6	*See* BNL-37066	E 1.99:	DE86001202	MN -34D	11:7962
CONF-8506198-	(International symposium on particles and the universe, Thessaloniki, Greece, 24-29 Jun 1985)				
2	*See* FNAL/C-85/134-A	E 1.99:	DE86002994	MN -34B	11:7890
CONF-8506196-	(Chapman conference ion acceleration, Wellesley, MA, USA, 3-7 Jun 1985)				
2	*See* LA-UR-85-3676	E 1.99:	DE86002409	MN -34B	11:7908
CONF-8506199-	(International astronomical union meeting, Princeton, NJ, USA, 24-28 Jun 1985)				
2	*See* LA-UR-85-3315	E 1.99:	DE86000822	MN -34B	11:7891
CONF-8506210-	(1. workshop on operator theory and applications, Amsterdam, Netherlands, 1 Jun 1985)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002450	MN -32	11:8152
CONF-8506213-	(State-of-the-art symposium on degradation of materials due to acid rain, Arlington, VA, USA, 17-19 Jun 1985)				
1	*See* BNL-36660	E 1.99:	DE86002506	MN -11	11:7506
CONF-8506216-	(Conference on obscuration and aerosol research, Edgewood, MD, USA, 19 Jun 1985)				
1	*See* PNL-SA-13237	E 1.99:	DE86001768	MN -11	11:7814
CONF-8506217-	(CRDC conference, Aberdeen, MD, USA, 17-21 Jun 1985)				
1	*See* LA-UR-85-3245	E 1.99:	DE86000767	MN -34A	11:7919
CONF-8506220-	(Satellite symposium monitoring of occupational exposure to genotoxicants, Helsinki, Finland, 30 Jun-2 Jul 1985)				
1	*See* UCRL-92369	E 1.99:	DE86003488	MN -48	11:7866
CONF-850716-	(7. international conference on ion beam analysis, Berlin, F.R. Germany, 7-12 Jul 1985)				
5	*See* UCRL-92816	E 1.99:	DE86003196	MN -34A	11:7765
CONF-850720-	(International nuclear reactor decommissioning planning conference, Bethesda, MD, USA, 16-18 Jul 1985)				
3	*See* PNL-SA-13082A	E 1.99:	TI85016270	MN -78	11:7193
5	*See* PNL-SA-13061		TI85016610	MN -80	11:7297
CONF-850721-	(International Europhysics conference on high energy physics, Bari, Italy, 18-24 Jul 1985)				
12	*See* LBL-20412	E 1.99:	DE86002880	MN -34D	11:7984
CONF-850735-	(Symposium on physics and chemistry of glass and glassmaking, Alfred, NY, USA, 30 Jul-2 Aug 1985)				
6	*See* DP-MS-85-54	E 1.99:	DE86003144	MN -70	11:7004
7	*See* DP-MS-85-65	E 1.99:	DE86003948	MN -70	11:7509
CONF-850768-	(SLAC summer institute on particle physics, Stanford, CA, USA, 23 Jul-3 Aug 1985)				
2	*See* LBL-20260	E 1.99:	DE86002886	MN -34D	11:7974
CONF-850785-	(5. international conference on physics in collision, Autun, France, 3-5 Jul 1985)				
5	*See* FNAL/C-85/134-A	E 1.99:	DE86002994	MN -34B	11:7890
CONF-850786-	(International conference on the physics and chemistry of boron and boron-rich borides, Albuquerque, NM, USA, 29-31 Jul 1985)				
5	*See* SAND-85-2442C	E 1.99:	DE86003495	MN -25	11:7491
7	*See* SAND-85-2584C	E 1.99:	DE86003725	MN -25	11:7492
CONF-850797-	(6. international symposium on 'fractals in physics', Trieste, Italy, 9-12 Jul 1985)				
2	*See* SAND-85-2156C	E 1.99:	DE86003496	MN -25	11:7521
CONF-850798-	(Workshop on unified string theories, Santa Barbara, CA, USA, 29 Jul-16 Aug 1985)				
2	*See* SLAC-PUB-3794	E 1.99:	DE86002936	MN -34D	11:7985
CONF-850799-	(4. IEA task workshop on electrolytic hydrogen production, Julich, F.R. Germany, 14-17 Jul 1985)				
3	*See* BNL-36755	E 1.99:	DE86000026	MN -94d	11:7059
CONF-850810-	(National heat transfer conference, Denver, CO, USA, 4-7 Aug 1985)				
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85006836	MN -78	11:7251
31	*See* SAND-84-8929	E 1.99:	DE86002840	MN -62a	11:7132
CONF-850814-	(Cryogenic engineering conference and international cryogenic materials conference, Boston, MA, USA, 12-16 Aug 1985)				
29	*See* LBL-19233	E 1.99:	DE86002865	MN -25	11:7450
30	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85018340	MN -25	11:7484
31	*See* DOE/ET/51013-163	E 1.99:	DE86003357	MN -20b	11:8100
CONF-850823-	(7. international conference on the strength of metals and alloys, Montreal, Canada, 12-16 Aug 1985)				
4	*See* DOE/ER/01367-158	E 1.99:	DE86001883	MN -25	11:7443
5	*See* DOE/ER/01367-157	E 1.99:	DE86001884	MN -25	11:7447

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CONF-850859-	(5. international congress on quantum chemistry, Montreal, Canada, 19-23 Aug 1985)			
2	*See* LBL-20089	E 1.99: DE86003993	MN -34A	11:8061
CONF-850869-	(Meeting of the Particles and Fields Division of the American Physical Society, Eugene, OR, USA, 12-15 Aug 1985)			
4	*See* SLAC-PUB-3763	E 1.99: DE86001458	MN -34D	11:7965
5	*See* SLAC-PUB-3815	E 1.99: DE86002158	MN -34D	11:7954
9	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86004055	MN -34B	11:7888
CONF-850871-	(International conference on neutron scattering, Santa Fe, NM, USA, 19-24 Aug 1985)			
20	*See* LA-UR-85-3571	E 1.99: DE86002401	MN -34A	11:7920
CONF-850883-	(19. international cosmic ray conference, La Jolla, CA, USA, 11-23 Aug 1985)			
10	*See* ANL-HEP-CP-85-100	E 1.99: DE86003062	MN -34B	11:7887
CONF-850887-	(SPIE international technical symposium on optical and electro-optical engineers, San Diego, CA, USA, 18-23 Aug 1985)			
41	*See* LA-UR-85-3834	E 1.99: DE86002430	MN -38	11:7612
43	NTIS, PC A02; 3	DE85018373	MN -25	11:7427
CONF-850890-	(International conference on magnetism, San Francisco, CA, USA, 26-30 Aug 1985)			
21	*See* LBL-20218	E 1.99: DE86001984	MN -25	11:7453
23	*See* LBL-19214	E 1.99: DE86002890	MN -25	11:7449
24	*See* BNL-37168	E 1.99: DE86002932	MN -25	11:7433
25	*See* BNL-37171	E 1.99: DE86002933	MN -25	11:7434
CONF-8508115-	(American Statistical Association for joint statistical meetings, Las Vegas, NV, USA, 5-8 Aug 1985)			
7	*See* PNL-SA-13252	E 1.99: DE86004021	MN -32	11:8158
CONF-8508119-	(NATO advanced study institute: advances in chemical reaction dynamics, Iraklion, Crete, 25 Aug-7 Sep 1985)			
2	*See* LA-UR-85-3846	E 1.99: DE86002429	MN -34A	11:7921
CONF-8508127-	(Nuclear chromodynamics conference, Santa Barbara, CA, USA, 12-13 Aug 1985)			
6	*See* SLAC-PUB-3787	E 1.99: DE86002941	MN -34C	11:8035
7	*See* SLAC-PUB-3795	E 1.99: DE86002935	MN -34D	11:7966
CONF-8508137-	(Ionic currents conference, Los Angeles, CA, USA, 2-4 Aug 1985)			
1	*See* BNL-36993	E 1.99: DE86001174	MN -94cc	11:7431
CONF-8508140-	(Bates Users Theory Group workshop (BUTG), Cambridge, MA, USA, 9-10 Aug 1985)			
2	*See* BNL-37035	E 1.99: DE86001185	MN -34C	11:7961
CONF-8508145-	(American Association of Physicists in medicine summer school, Portland, OR, USA, 4-9 Aug 1985)			
1	*See* LBL-20053	E 1.99: DE86002966	MN -48	11:7871
CONF-8508146-	(Minnowbrook conference on life prediction for high temperature gas turbine materials, Blue Mountain Lake, NY, USA, 27-30 Aug 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86001814	MN -25	11:7436
CONF-8508148-	(Conference on research work at the U.C. Research Station at White Mountain, Bishop, CA, USA, 30-31 Aug 1985)			
1	*See* LBL-20344	E 1.99: DE86002888	MN -34B	11:7892
CONF-850902-	(2. international symposium on environmental degradation of materials in nuclear power systems--water reactors, Monterey, CA, USA, 9-12 Sep 1985)			
8	*See* BNL-NUREG-37001	TI86002510	MN -25	11:7435
CONF-850903-	(International topical meeting on computer applications for nuclear power plant operation and control, Pasco, WA, USA, 8-12 Sep 1985)			
20	*See* HEDL-SA-3278	E 1.99: DE85018468	MN -78	11:7231
CONF-850918-	(International topical meeting on high level nuclear waste disposal - technology and engineering, Pasco, WA, USA, 24-26 Sep 1985)			
8	*See* SAND-85-0559C	E 1.99: DE86003242	MN -70	11:7025
CONF-850920-	(9. international conference on magnet technology, Zurich, Switzerland, 9-13 Sep 1985)			
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86002215	MN -20	11:8091
8	*See* LA-UR-85-2943	E 1.99: DE86002393	MN -38	11:7628
CONF-850921-	(5. international conference on hypernuclear and kaon physics, Upton, NY, USA, 9-13 Sep 1985)			
2	*See* LA-UR-85-3825	E 1.99: DE86001698	MN -34C	11:8003
3	*See* LA-UR-85-3524	E 1.99: DE86002387	MN -34C	11:7964
CONF-850937-	(28. conference on analytical chemistry, Knoxville, TN, USA, 30 Sep-3 Oct 1985)			
4	*See* DP-MS-85-56	E 1.99: DE86003143	MN -70	11:7005
CONF-850942-	(190. American Chemical Society national meeting, Chicago, IL, USA, 8-13 Sep 1985)			
33	*See* DOE/ER/03346-263	E 1.99: DE86001895	MN -34C	11:8015
34	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86002196	MN -34C	11:8031
36	*See* BNL-37159	E 1.99: DE86002926	MN -34C	11:7995
39	*See* LBL-20300	E 1.99: DE86002887	MN -34C	11:8026
40	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86003056	MN -34C	11:8022

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41	*See* BNL-37198	E 1.99:	DE86003637	MN -34	11:8014
CONF-850956-	(7. international free-electron laser conference, Tahoe City, CA, USA, 8-13 Sep 1985)				
5	*See* LA-UR-85-3212	E 1.99:	DE86002392	MN -34A	11:8059
6	*See* LA-UR-85-3854	E 1.99:	DE86002426	MN -38	11:7649
7	*See* UCRL-93174	E 1.99:	DE86002372	MN -28	11:7713
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003055	MN -38	11:7642
9	*See* UCRL-93456	E 1.99:	DE86002373	MN -28	11:7714
10	*See* LBL-19939	E 1.99:	DE86002866	MN -38	11:7652
11	*See* LA-UR-85-3166	E 1.99:	DE86000782	MN -34	11:7644
12	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001112	MN -34	11:7696
15	*See* LA-UR-85-4071	E 1.99:	DE86003656	MN -38	11:7651
18	*See* LA-UR-85-4034	E 1.99:	DE86003665	MN -38	11:7630
CONF-8509105-	(2. Bucharest international conference on trends in quantum mechanics, Bucharest, Romania, 2-6 Sep 1985)				
1	*See* LA-UR-85-3560	E 1.99:	DE86002404	MN -38	11:7646
CONF-8509121-	(7. annual DOE LLWMP participants information meeting, Las Vegas, NV, USA, 10-13 Sep 1985)				
22	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003318	MN -70B	11:6995
24	*See* BNL-37184	E 1.99:	DE86003632	MN -70B	11:6993
CONF-8509142-	(Geothermal program review, Washington, DC, USA, 11-12 Sep 1985)				
8	*See* EGG-M-22585	E 1.99:	DE86003219	MN -66a	11:7151
CONF-8509147-	(ACTINIDES '85, Aix-en-Provence, France, 1-6 Sep 1985)				
11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002223	MN -34C	11:8023
12	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004035	MN -25	11:7486
CONF-8509150-	(NATO advanced study institute, San Miniato, Italy, 2-13 Sep 1985)				
2	*See* SAND-85-1349C	E 1.99:	DE86002589	MN -25	11:7518
4	*See* UCRL-93632	E 1.99:	DE86003886	MN -25	11:7465
CONF-8509168-	(Electron microscopy and analysis group conference, Newcastle-Upon-Tyne, England, 2-5 Sep 1985)				
3	*See* LBL-19947	E 1.99:	DE86002891	MN -25	11:7452
CONF-8509171-	(3. research coordination meeting of the IAEA co-ordinated research program, Cadarache, France, 9-19 Sep 1985)				
1	*See* PNL-SA-13354		TI85018528	MN -51	11:7044
CONF-8509189-	(CERN FASTBUS software workshop, Geneva, Switzerland, 23-24 Sep 1985)				
1	*See* FNAL-TM-1359	E 1.99:	DE86002544	STD -32	11:7707
CONF-8509190-	(American Protein Chemists symposium, San Diego, CA, USA, 30 Sep-2 Oct 1985)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002274	MN -48	11:7098
CONF-8509191-	(16. international utility nuclear fuel performance conference, Dallas, TX, USA, 30 Sep-2 Oct 1985)				
1	*See* TVA/PE/NP-85/14		DE86900230	MN -78	11:7225
CONF-8509192-	(Course and workshop on applications of RF waves to tokamak devices, Varenna, Italy, 5-14 Sep 1985)				
2	*See* DOE/ET/51013-162	E 1.99:	DE86003363	MN -20	11:8071
CONF-8509200-	(Parallel computing conference, West Berlin, F.R. Germany, 23 Sep 1985)				
1	*See* UCRL-93564	E 1.99:	DE86002989	MN -32	11:8165
2	*See* LA-UR-85-3597	E 1.99:	DE86002420	MN -32	11:8155
CONF-8509201-	(11. international conference on amorphous semiconductors, Rome, Italy, 2-6 Sep 1985)				
2	*See* LBL-20184	E 1.99:	DE86002874	MN -25	11:7511
CONF-8509204-	(Symposium on low cycle fatigue-directions for the future, Bolton Landing, NY, USA, 30 Sep-4 Oct 1985)				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003317	MN -25	11:7437
CONF-851003-	(Conference on coal science, Sydney, Australia, 28 Oct-1 Nov 1985)				
13	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002251	MN -90a	11:6911
CONF-851007-	(3. international meeting on reactor thermal hydraulics, Newport, RI, USA, 15-18 Oct 1985)				
14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002258	MN -79e	11:7203
CONF-851009-	(IEEE nuclear science symposium, San Francisco, CA, USA, 23-25 Oct 1985)				
7	*See* LA-UR-85-3735	E 1.99:	DE86002442	MN -15	11:7057
8	*See* LA-UR-85-3803	E 1.99:	DE86002435	MN -38	11:7771
13	*See* SLAC-PUB-3811	E 1.99:	DE86002944	MN -28	11:7763
15	*See* SLAC-PUB-3777	E 1.99:	DE86002938	MN -28	11:7761
17	*See* SLAC-PUB-3790	E 1.99:	DE86002942	MN -28	11:7762
18	*See* UCRL-92719	E 1.99:	DE86002856	MN -38	11:7764
19	*See* UCRL-92718	E 1.99:	DE86002857	MN -20a	11:8073
20	*See* FNAL/C-85/150	E 1.99:	DE86003033	MN -28	11:7753
21	*See* FNAL/C-85/156	E 1.99:	DE86003030	MN -28	11:7754
26	*See* FNAL-TM-1363	E 1.99:	DE86003546	STD -28	11:7756
28	*See* LBL-19640	E 1.99:	DE86003996	MN -41	11:7779
30	*See* LBL-19665	E 1.99:	DE86003992	MN -37	11:7759

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CONF-851011-	(4. symposium on separation science and technology for energy applications, Knoxville, TN, USA, 20-24 Oct 1985)			
6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86003094	MN -61E	11:7070
CONF-851027-	(Health and environmental research on complex organic mixtures, Richland, WA, USA, 21-24 Oct 1985)			
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86003309	MN -90i	11:6891
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86003310	MN -92	11:6952
CONF-851048-	(168. meeting of the Electrochemical Society, Las Vegas, NV, USA, 13-18 Oct 1985)			
9	*See* LBL-20326	E 1.99: DE86002878	MN -25	11:7454
CONF-851052-	(17. annual symposium on optical materials for high-power lasers, Boulder, CO, USA, 28-30 Oct 1985)			
1	*See* LA-UR-85-3785	E 1.99: DE86003689	MN -38	11:7648
CONF-851053-	(7. international workshop on laser interaction and related plasma phenomena, Monterey, CA, USA, 28 Oct-1 Nov 1985)			
2	*See* LA-UR-85-3851	E 1.99: DE86002427	MN -21	11:8102
3	*See* LA-UR-85-3855	E 1.99: DE86002425	MN -21	11:8103
6	*See* LA-UR-85-3957	E 1.99: DE86003682	MN -38	11:7629
CONF-851060-	(4. DOE workshop on computer aided engineering, Upton, NY, USA, 10-11 Oct 1985)			
1	*See* SLAC-PUB-3793	E 1.99: DE86003860	MN -38	11:7614
CONF-851082-	(European conference on gaseous effluent treatment in nuclear installations, Luxembourg, Luxembourg, 14-18 Oct 1985)			
2	*See* RFP-3777	E 1.99: DE86001262	MN -11	11:7820
CONF-8510118-	(DOE's natural phenomena hazards mitigation conference, Las Vegas, NV, USA, 7-11 Oct 1985)			
9	*See* EGG-M-10085	E 1.99: DE86003217	MN -11	11:7674
CONF-8510131-	(Workshop on systems performance assessments for the safety of radioactive waste disposal, Paris, France, 22-24 Oct 1985)			
2	*See* PNL-SA-13475	E 1.99: DE86004029	MN -70	11:7019
CONF-8510137-	(International workshop on nuclear structure at high spin, high excitation, and high momentum transfer, Spencer, IN, USA, 21-23 Oct 1985)			
1	*See* LA-UR-85-3664	E 1.99: DE86002412	MN -34C	11:8017
CONF-8510151-	(28. Oak Ridge National Laboratory conference on analytical chemistry, Knoxville, TN, USA, 1-3 Oct 1985)			
12	*See* LA-UR-85-3544	E 1.99: DE86002385	MN -37	11:7758
13	*See* DP-MS-85-66	E 1.99: DE86003147	MN -4	11:7565
14	*See* PNL-SA-13359	E 1.99: DE86004027	MN -41	11:7815
CONF-8510158-	(Two phase combustion, numerical modelling of combustion processes: general combustion topics, Davis, CA, USA, 21-22 Oct 1985)			
4	*See* LBL-19922	E 1.99: DE86001991	MN -38	11:7631
5	*See* UCRL-93619	E 1.99: DE86003887	MN -4	11:7597
CONF-8510160-	(ASM metals congress - international conference on surface modifications, Toronto, Ontario, Canada, 13-18 Oct 1985)			
7	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86002240	MN -25	11:7438
8	*See* SAND-85-1961C	E 1.99: DE86002916	MN -25	11:7459
CONF-8510162-	(GRI basic research contractor's review meeting on gaseous fuel synthesis from inorganic resources, Chicago, IL, USA, 16-17 Oct 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86000092	MN -61G	11:7060
CONF-8510168-	(TMS/AIME fall meeting, Toronto, Canada, 13-17 Oct 1985)			
1	*See* BNL-37094	E 1.99: DE86001180	MN -25	11:7432
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86003272	MN -25	11:7508
CONF-8510172-	(3. international conference and workshop on radiative properties of hot dense matter, Williamsburg, VA, USA, 14-18 Oct 1985)			
2	*See* UCRL-93608	E 1.99: DE86003471	MN -34A	11:7924
CONF-8510173-	(13. water reactor safety research information meeting, Gaithersburg, MD, USA, 22-25 Oct 1985)			
7	*See* SAND-85-2026C	TI86001753	MN -78	11:7300
8	*See* PNL-SA-13489	TI86002055	MN -78	11:7194
9	*See* SAND-85-1848C	TI86002122	MN -78	11:7299
12	*See* SAND-85-2084C	TI86002127	MN -78	11:7301
24	NTIS, PC A02/MF A01; 1	TI86003308	MN -78	11:7253
25	NTIS, PC A02/MF A01 - GPO	TI86003068	MN -78	11:7439
26	*See* EGG-M-27385	E 1.99: DE86003226	MN -78	11:7259
27	NTIS, PC A02/MF A01 - GPO	TI86003079	MN -78	11:7440
29	NTIS, PC A02/MF A01 - GPO	TI86003321	MN -78	11:7254
31	*See* EGG-M-23485	E 1.99: DE86003224	MN -78	11:7258
32	*See* EGG-M-20985	E 1.99: DE86003220	MN -78	11:7257
34	*See* LA-UR-85-3902	TI86003687	MN -78	11:7266
Summa.	*See* NUREG/CP-0071	TI86900128	MN -78	11:7272

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CONF-8510176-	(3. symposium on energy engineering sciences: thermofluids and solid mechanics, University Park, PA, USA, 8-10 Oct 1985)				
3	*See* EGG-M-26385	E 1.99:	DE86003218	MN -38	11:7446
CONF-8510178-	(Du Pont process analytical symposium, Wilmington, DE, USA, 16-17 Oct 1985)				
2	*See* DP-MS-85-127	E 1.99:	DE86003142	MN -37	11:7773
3	*See* DP-MS-85-142	E 1.99:	DE86003141	MN -37	11:7774
CONF-8510182-	(Fall meeting of the American Flame Research Committee, Livermore, CA, USA, 17-18 Oct 1985)				
2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003096	MN -90e	11:6935
CONF-8510185-	(Workshop on dosimetry of beta particles and low energy X-rays, Paris, France, 7-9 Oct 1985)				
2	*See* EGG-M-04985	E 1.99:	DE86004106	MN -48	11:7752
CONF-8510194-	(2. international workshop on accelerator control systems, Los Alamos, NM, USA, 7-10 Oct 1985)				
3	*See* LA-UR-85-3518	E 1.99:	DE86002390	MN -21	11:8154
5	*See* LA-UR-85-3582	E 1.99:	DE86002397	MN -28	11:7748
7	*See* LA-UR-85-3579	E 1.99:	DE86002400	MN -28	11:7708
8	*See* LA-UR-85-3580	E 1.99:	DE86002399	MN -28	11:7747
CONF-8510199-	(5. international workshop on immune-deficient animals, Copenhagen, Denmark, 13-16 Oct 1985)				
1	*See* LA-UR-85-3634	E 1.99:	DE86002415	MN -48	11:7849
CONF-8510206-	(3. international symposium on laboratory robotics, Boston, MA, USA, 20-23 Oct 1985)				
1	*See* DP-MS-85-32	E 1.99:	DE86000560	MN -38	11:7626
CONF-8510207-	(Applicon users group fall technical meeting, Boston, MA, USA, 28 Oct 1985)				
1	*See* BDX-613-3387	E 1.99:	DE86003130	MN -32	11:8151
2	*See* BDX-613-3386	E 1.99:	DE86003129	MN -32	11:8150
CONF-8510213-	(IEEE careers conference, Boston, MA, USA, 3-4 Oct 1985)				
1	*See* UCRL-93393	E 1.99:	DE86002853	MN -13	11:8146
CONF-8510214-	(3. international symposium on acoustic remote sensing of the atmosphere and oceans, Paris, France, 14-17 Oct 1985)				
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003041	MN -11	11:7800
CONF-8510218-	(Field data acquisition for building and equipment energy-use monitoring national workshop, Dallas, TX, USA, 16 Oct 1985)				
2	*See* PNL-SA-13446	E 1.99:	DE86001772	MN -37	11:7781
CONF-8510221-	(Committee on the Safety of Nuclear Installations (CSNI) specialist meeting on operating experience relating to on-site electric power sources, London, UK, 16-18 Oct 1985)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002250	MN -80	11:7221
CONF-8510223-	(Annual meeting of the Society for Risk Analysis, Alexandria, VA, USA, 6-9 Oct 1985)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003274	MN -80	11:7255
CONF-8510225-	(Hanford life sciences symposium, Richland, WA, USA, 21-24 Oct 1985)				
1	*See* LA-UR-85-3568	E 1.99:	DE86002403	MN -48	11:7863
CONF-8510231-	(2. annual international SIR user group conference, Smokie, IL, USA, 21-23 Oct 1985)				
1	*See* BNL-37138	E 1.99:	DE86003371	MN -11	11:7818
CONF-8510232-	(13. Department of Energy (DOE) compatibility meeting, Oak Ridge, TN, USA, 15-17 Oct 1985)				
1	*See* MLM-3312(OP)	E 1.99:	DE86003448	MN -25	11:7789
CONF-851102-	(11. symposium on engineering problems in fusion research, Austin, TX, USA, 18-22 Nov 1985)				
2	*See* UCRL-92623	E 1.99:	DE86002376	MN -20b	11:8109
3	*See* UCRL-92528	E 1.99:	DE86002965	MN -20b	11:8107
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003008	MN -20	11:8092
11	*See* UCRL-92558	E 1.99:	DE86003195	MN -21	11:8108
12	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003323	MN -21	11:8093
13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003312	MN -20	11:8094
14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003324	MN -20a	11:8095
15	NTIS, PC A02; 3 - GPO		DE86003315	MN -20	11:8096
CONF-851106-	(Industrial heat exchanger technology symposium, Pittsburgh, PA, USA, 6-8 Nov 1985)				
3	*See* PNL-SA-13264	E 1.99:	DE86002816	MN -38	11:7632
CONF-851115-	(American Nuclear Society winter meeting, San Francisco, CA, USA, 10-15 Nov 1985)				
8	NTIS, PC A02/MF A01		TI85014660	MN -78	11:7235
10	*See* UCRL-92891	E 1.99:	DE85016285	MN -70	11:7031
11	*See* BNL-NUREG-36889		TI85017839	MN -78	11:7249
12	*See* BNL-NUREG-36890		TI85017838	MN -85	11:6981
16	*See* HEDL-SA-3323-FP	E 1.99:	DE85018501	MN -79	11:7238
17	*See* HEDL-SA-3333-FP	E 1.99:	DE85018474	MN -79g	11:7239
26	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002182	MN -71	11:7623
28	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002190	MN -80	11:7215
30	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002180	MN -79	11:7204
31	NTIS, PC A02/MF A01 - GPO		TI86002187	MN -80	11:7216
35	NTIS, PC A02/MF A01		TI86002456	MN -78	11:7252

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36	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86002451	MN -38	11:7668
CONF-851125-	(American Society of Mechanical Engineers winter annual meeting, Miami, FL, USA, 17-21 Nov 1985)			
16	*See* MLM-3316(OP)	E 1.99: DE86003733	MN -23	11:7058
CONF-851136-	(Meeting of the Plasma Physics Division of the American Physical Society, San Diego, CA, USA, 4-8 Nov 1985)			
2	*See* SAND-85-2384C	DE86002922	MN -25	11:7460
3	*See* SAND-85-2371C	E 1.99: DE86002919	MN -28	11:7712
CONF-851151-	(11. world conference on nondestructive testing, Las Vegas, NV, USA, 3-8 Nov 1985)			
3	*See* BDX-613-3413	E 1.99: DE86003133	MN -38	11:7667
CONF-851155-	(Annual emissions inventory symposium, Charleston, SC, USA, 12-14 Nov 1985)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86004038	MN -11	11:7803
CONF-851157-	(Specialists' meeting on the use of the optical model for the calculation of neutron cross sections below 20 MeV, Paris, France, 13-15 Nov 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86003305	MN -34C	11:8032
CONF-851160-	(Air Pollution Control Association Pacific Northwest international section annual meeting, Calgary, Canada, 13-15 Nov 1985)			
2	*See* PNL-SA-13178	E 1.99: DE86003558	MN -90i	11:6944
CONF-851174-	(32. national vacuum symposium and topical conference, Houston, TX, USA, 19-22 Nov 1985)			
1-Rev.1	*See* UCRL-92700-Rev.1	E 1.99: DE86002171	MN -20d	11:8110
6-Rev.1	*See* UCRL-93356-Rev.1	E 1.99: DE86003481	MN -4	11:8111
14	*See* RFP-3884	E 1.99: DE86001564	MN -38	11:7634
15	*See* SAND-85-1266C	E 1.99: DE86003235	MN -20a	11:8104
17	*See* MLM-3319(OP)	E 1.99: DE86003729	MN -4	11:7604
CONF-851185-	(International laser science conference, Dallas, TX, USA, 18-22 Nov 1985)			
1	*See* UCRL-93584	E 1.99: DE86003491	MN -22	11:6977
CONF-8511103-	(ICALEO international congress on the applications of lasers and electro-optics, San Francisco, CA, USA, 11-14 Nov 1985)			
2	*See* UCRL-93463	E 1.99: DE86002370	MN -38	11:7654
3	*See* EGG-10282-2083	E 1.99: DE86003028	MN -38	11:7775
4	*See* MLM-3320(OP)	E 1.99: DE86003731	MN -25	11:7455
CONF-8511110-	(JANNAF Safety and Environmental Protection Subcommittee meeting, Monterey, CA, USA, 4-8 Nov 1985)			
2	*See* UCRL-92482	E 1.99: DE86001907	MN -41	11:7816
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86004049	MN -11	11:7833
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86004048	MN -11	11:7806
CONF-8511111-	(Unconventional gas recovery contractors' meeting, Morgantown, WV, USA, 18-19 Nov 1985)			
1	*See* SAND-85-2399C	E 1.99: DE86003236	MN -92a	11:6963
2	*See* SAND-85-2401C	E 1.99: DE86003238	MN -92a	11:6965
3	*See* SAND-85-2398C	E 1.99: DE86003241	MN -92a	11:6958
4	*See* SAND-85-2396C	E 1.99: DE86003240	MN -92a	11:6961
5	*See* SAND-85-2397C	E 1.99: DE86003239	MN -92a	11:6962
6	*See* SAND-85-2400C	E 1.99: DE86003237	MN -92a	11:6964
CONF-8511113-	(3. conference of fabric filter technology for coal-fired power plants, Scottsdale, AZ, USA, 12-14 Nov 1985)			
2	*See* DOE/FE/60181-158	E 1.99: DE86003205	MN -90i	11:7808
CONF-8511118-	(7. US-Japan workshop on compact toroids, Bellevue, WA, USA, 12-13 Nov 1985)			
1	*See* LA-UR-85-3850	E 1.99: DE86002428	MN -20d	11:8101
CONF-8511126-	(International symposium on flux pinning and electromagnetic properties in superconductors, Fukuoka, Japan, 11-14 Nov 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86003090	MN -25	11:7441
2	NTIS, PC A02; 3	DE86003319	MN -20b	11:8097
CONF-8511127-	(Conference on technology and science, Newton, MA, USA, 29 Nov-1 Dec 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86001795	MN -48	11:7837
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86003069	MN -70	11:7049
CONF-8511129-	(RAWG robotic and automation workshop, Los Alamos, NM, USA, 21-22 Nov 1985)			
1	*See* DP-MS-85-139	E 1.99: DE86003146	MN -38	11:7627
CONF-8511132-	(DOE ceramics conference, Livermore, CA, USA, 20-22 Nov 1985)			
1	*See* SAND-85-2104C	E 1.99: DE86003173	MN -25	11:7520
CONF-851201-	(7. Miami international conference on alternative energy sources, Miami Beach, FL, USA, 9-11 Dec 1985)			
2	*See* SLAC-PUB-3791	E 1.99: DE86003863	MN -05	11:7340
CONF-851217-	(Materials Research Society meeting, Boston, MA, USA, 2-7 Dec 1985)			
3	*See* EGG-M-11985	E 1.99: DE86003245	MN -25	11:7445
4	*See* SAND-85-1177C	E 1.99: DE86003500	MN -25	11:7515
5	*See* SAND-85-1348C	E 1.99: DE86003726	MN -25	11:7517

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6	*See* SAND-85-1333C	E 1.99:	DE86003568	MN -25	11:7516
7	*See* SAND-85-2607C	E 1.99:	DE86003713	MN -25	11:7502
8	*See* SAND-85-1598C		DE86003714	MN -25	11:7519
9	*See* SAND-85-1636C	E 1.99:	DE86003715	MN -25	11:8051
10	*See* SAND-85-2619C	E 1.99:	DE86003723	MN -25	11:7461
CONF-851237-	(IEEE international electron devices meeting, Washington, DC, USA, 1-4 Dec 1985)				
2	*See* UCRL-92947	E 1.99:	DE86002598	MN -38	11:7682
CONF-851245-	(2. conference on artificial intelligence applications, Miami Beach, FL, USA, 11-13 Dec 1985)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001358	MN -38	11:7624
CONF-860106-	(ASHRAE semi-annual meeting, San Francisco, CA, USA, 19-22 Jan 1986)				
1	*See* LBL-19383	E 1.99:	DE85014541	MN -94a	11:7394
CONF-860107-	(19. annual Hawaii international conference on system sciences, Honolulu, HI, USA, 8-10 Jan 1986)				
1	*See* UCRL-92925	E 1.99:	DE85015176	MN -32	11:8164
CONF-860113-	(65. annual meeting of the Transportation Research Board, Washington, DC, USA, 20-22 Jan 1986)				
1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85018352	MN -90i	11:7804
2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002236	MN -96	11:7400
CONF-860116-	(IEEE winter power meeting, New York City, NY, USA, 1 Jan 1986)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000089	MN -35	11:7793
CONF-860119-	(Society for Computer Simulation (SCS) multiconference, San Diego, CA, USA, 23-25 Jan 1986)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001791	MN -96	11:7424
2	*See* UCRL-93522	E 1.99:	DE86001906	MN -32	11:7939
3	*See* DP-MS-85-63	E 1.99:	DE86001966	MN -15	11:7230
CONF-860224-	(4. international modal analysis conference, Los Angeles, CA, USA, 3-6 Feb 1986)				
4	*See* SAND-85-1301C	E 1.99:	DE86002588	MN -38	11:7613
CONF-860924-	(10. world computer congress, Dublin, Ireland, 1 Sep 1986)				
1	*See* LBL-20084	E 1.99:	DE86000601	MN -32	11:8156
COO-					
1367-157	*See* DOE/ER/01367-157	E 1.99:	DE86001884	MN -25	11:7442
1367-158	*See* DOE/ER/01367-158	E 1.99:	DE86001883	MN -25	11:7443
CRS-					
IB-75012	Congressional Research Service, The Library of Congress, Washington, DC		TI85902172	MN -70	11:7333
CT-					
79-002	*See* DOE/R1/10063-T1	E 1.99:	DE86000387	MN -97e	11:7685
DES-					
74-94	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86003505	MN -11	11:7828
75-9	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003506	MN -11	11:7829
DOE/AL/05346-					
T3	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003387	MN -70	11:6996
DOE/AL/17842-					
T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003522	MN -15	11:7056
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1	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004191	MN -11	11:7085
DOE/BP/12910-					
1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003967	MN -11	11:7839
3	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003968	MN -11	11:7840
DOE/BP/13102-					
1	NTIS, PC A12/MF A01; 1		DE86003923	MN -11	11:7086
2	NTIS, PC A19/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003920	MN -11	11:7087
DOE/BP/27780-					
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003962	MN -11	11:7088
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0043/ 3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003964	MN -95	11:7374
0115/ 3	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002019	MN -95	11:7335
DOE/CE/15088-					
T2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003001	MN -62b	11:7130
DOE/CE/15128-					
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DOE/CE/15156-					
T1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003696	MN -95d	11:7380
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T6	NTIS, PC A22/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003706	MN -95d	11:7384
T11	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003703	MN -95d	11:7385
T12	NTIS, PC A19/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003697	MN -95d	11:7386
T13	NTIS, PC A17/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003709	MN -95d	11:7387
DOE/CE/50070-					
T5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003885	MN -90	11:6892
DOE/CE/64780-					
T4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003869	MN -95	11:7325
DOE/CP/11936-					
T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003365	MN -13	11:7329
DOE/CS/20336-					
T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003584	MN -95	11:7388

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DOE/CS/40402-T5	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002290	MN -95f	11:7406
DOE/CS/62029-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003940	MN -13	11:7336
DOE/CS/80010-T9	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003905	MN -61D	11:7071
DOE/EI/10653-T1	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017607	MN -90	11:6925
DOE/EI/19691-T1	NTIS, PC A03; 3		DE86003844	MN -98B	11:6948
DOE/EIA-0035(85/ 08)	NTIS, PC A07/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86003760	MN -98	11:7356
0109(85/ 09)	NTIS, PC A06/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86003803	MN -98B	11:6949
0130(85/ 09)	NTIS, PC A08/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86003613	MN -98C	11:6960
0167(84)	NTIS, PC A07/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86004078	MN -98C	11:6966
0226(80/ 06)	NTIS, PC A07/MF A01 - GPO (GPO Dep.)	E 1.99:	DE86002475	MN -98E	11:7341
0226(80/ 11)	NTIS, PC A07/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86002470	MN -98E	11:7342
0226(80/ 12)	NTIS, PC A07/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86002469	MN -98E	11:7343
0226(81/ 01)	NTIS, PC A07/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86002477	MN -98E	11:7344
0226(81/ 03)	NTIS, PC A07/MF A01 - GPO (GPO Dep.)	E 1.99:	DE86002478	MN -98E	11:7345
0226(81/ 04)	NTIS, PC A07/MF A01 - GPO (GPO Dep.)	E 1.99:	DE86002479	MN -98E	11:7346
0226(81/ 07)	NTIS, PC A07/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86002481	MN -98E	11:7347
0226(83/ 01)	NTIS, PC A03/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE83011098	MN -98E	11:7348
0226(85/ 08)	NTIS, PC A03/MF A01 - GPO (GPO Dep.)	E 1.99:	DE86003383	MN -98E	11:7349
0380(85/ 09)	NTIS, PC A08/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE86003956	MN -98B	11:6950
0436(85)	NTIS, PC A06/MF A01 - GPO (GPO Dep.)	E 1.99:	DE86004077	MN -98	11:6986
DOE/ER/01195-501-1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002464	MN -38	11:7676
DOE/ER/01367-157	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001884	MN -25	11:7442
158	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001883	MN -25	11:7443
DOE/ER/02696-31	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002813	MN -34C	11:8033
DOE/ER/03346-263	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001895	MN -34C	11:8015
DOE/ER/03948-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003458	MN -34D	11:8002
DOE/ER/04054-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003831	MN -11	11:7883
DOE/ER/04178-9	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001851	MN -94	11:7323
DOE/ER/04650-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003362	MN -4	11:7607
DOE/ER/04987-6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003516	MN -4	11:7570
DOE/ER/05007-22	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003169	MN -34	11:7889
DOE/ER/10008-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003763	MN -13	11:7331
DOE/ER/10336-7	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003519	MN -34D	11:7979
DOE/ER/10376-T6	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002908	MN -34	11:7911
DOE/ER/10683-6	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86003564	MN -48	11:7843
DOE/ER/10829-6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003857	MN -4	11:7573
DOE/ER/10830-4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003150	MN -4	11:7574
DOE/ER/10855-5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003359	MN -25	11:7444
DOE/ER/10947-4	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003771	MN -34	11:7608
DOE/ER/12049-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003970	MN -38	11:7662
DOE/ER/13038-T2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002129	MN -38	11:7611
DOE/ER/13278-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003749	MN -48	11:7844
DOE/ER/13302-1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003735	MN -21	11:8098
DOE/ER/13339-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003849	MN -48	11:7845
DOE/ER/13352-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003433	MN -48	11:7846
DOE/ER/30060-T1	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002003	STD -93A	11:7368
DOE/ER/40033-102	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003520	MN -34D	11:7980
DOE/ER/40098-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003533	MN -34C	11:7997
DOE/ER/40130-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003153	MN -34D	11:7949

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DOE/ER/45069-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003864	MN -25	11:7487
T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003865	MN -25	11:7488
DOE/ER/45132-3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003830	MN -34A	11:8048
DOE/ER/45158-2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002953	MN -38	11:7643
DOE/ER/52085-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001844	MN -20	11:8099
DOE/ER/60043-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003692	MN -92	11:6953
T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003691	MN -92	11:6954
DOE/ER/60203-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004090	MN -48	11:7854
DOE/ER/60311-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003918	MN -11	11:7831
DOE/ET/10815-111	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003456	STD -90g	11:7361
112	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003457	STD -90g	11:7362
DOE/ET/11304-30	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003198	STD -93A	11:7369
31	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003199	STD -93A	11:7370
33	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003200	STD -93A	11:7371
34	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003201	STD -93A	11:7372
DOE/ET/20372-T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002176	MN -60	11:7167
DOE/ET/27030-7	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004136	MN -66g	11:7154
DOE/ET/34212-47	NTIS (US Sales Only), PC A06/MF A01 (GPO Dep.)	E 1.99:	DE86003758	STD -78	11:7197
DOE/ET/51013-162	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003363	MN -20	11:8071
163	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003357	MN -20b	11:8100
DOE/EV/00639-27	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003739	MN -48	11:7832
DOE/EV/04580-6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004089	MN -48	11:7861
DOE/EV/10237-T2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003859	MN -90a	11:6912
DOE/EV/10321-T1	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE86003382	MN -11	11:7862
DOE/FC/10616-1965	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003856	STD -90i	11:7807
DOE/FE/60177-1955	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002050	STD -91	11:6968
1975	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE86003738	STD -91	11:6969
1976	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003743	STD -91	11:6970
1979	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003880	STD -91	11:6971
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1869	NTIS, PC A20/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003717	STD -90	11:6936
DOE/FE/60294-T1	NTIS, PC A11; 3		DE86003773	MN -90	11:6943
DOE/ID/12079-125	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002010	MN -66a	11:7140
126	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002012	MN -66a	11:7141
DOE/ID/12466-T1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003247	MN -70B	11:6997
T2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003246	MN -70B	11:6998
DOE/IG-0008/ 9	USDOE-TIC, PO Bx 62, Oak Ridge, TN 37830		TI86003937	STD -13	11:8140
DOE/JPL/957175-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003427	MN -63	11:7099
DOE/LC/10402-1920	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85011525	STD -91	11:6920
DOE/LLW-42T-Rev.1	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86004109	MN -70B	11:6999
DOE/MA-0008/ 17	NTIS, PC A02/MF A01; 1		DE85017502	MN -13	11:8141
DOE/MA/00194-1	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004364	MN -13	11:8138
DOE/MC/12010-T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003437	MN -92	11:6945
DOE/MC/14521-1961	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001010	MN -92	11:6959
DOE/MC/21315-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002833	MN -90c	11:6926
DOE/MC/21385-1928	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85016904	STD -90c	11:6893
DOE/NASA-0290-1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003906	STD -96	11:7425

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DOE/NBB-0073	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003875	MN -96	11:7401
DOE/NBM-5017971	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85017971	MN -80	11:7188
5018245	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018245	MN -51	11:6972
5018252	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85018252	MN -83	11:6987
6003517	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86003517	MN -11	11:7799
6004155	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86004155	MN -13	11:7332
DOE/NV/10250-22	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86004084	MN -70	11:6982
DOE/OR/21400-T206	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002962	MN -38	11:7794
T209	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003303	MN -48	11:7847
DOE/OT/21400-T3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003597	MN -34A	11:7593
T4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003601	MN -22	11:7563
T5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003598	MN -4	11:7594
T7	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003599	MN -22	11:7050
T8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003596	MN -34C	11:8024
T9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003595	MN -34C	11:8025
T10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003594	MN -4	11:7564
T11	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003593	MN -4	11:7595
T12	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003585	MN -4	11:7575
DOE/PC/40009-T12	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003770	MN -90d	11:6894
DOE/PC/40804-T12	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003579	MN -90c	11:6939
T15	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86003646	MN -90c	11:7663
T16	NTIS, PC A09/MF A01 (GPO Dep.)	E 1.99:	DE86003643	MN -90c	11:7664
DOE/PC/50266-11-12	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003072	MN -90b	11:6940
DOE/PC/50798-T11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003757	MN -90c	11:6895
DOE/PC/50800-T12	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002921	MN -90a	11:6896
DOE/PC/50804-11	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004169	MN -90a	11:7069
DOE/PC/60039-7	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003565	MN -90d	11:6897
DOE/PC/60800-8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003575	MN -90c	11:6913
DOE/PC/60807-8	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003740	MN -90a	11:6955
DOE/PC/63032-T6	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018277	MN -90b	11:6898
T7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003911	MN -90b	11:6899
DOE/PC/70003-T6	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002987	MN -90d	11:6900
DOE/PC/70770-5	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86003640	MN -90e	11:6941
DOE/PC/70773-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003622	MN -90	11:6914
DOE/PC/70778-T5	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003037	MN -90a	11:6915
DOE/PC/70795-T5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003736	MN -90a	11:6916
DOE/PC/72001-T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002457	MN -90b	11:6927
DOE/PC/72007-T6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003734	MN -90b	11:6928
DOE/PC/72008-T3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000312	MN -90b	11:6901
DOE/PC/79892-T4	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003270	MN -90d	11:6902
DOE/PC/80016-T1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002986	MN -90d	11:6903
DOE/PC/80514-01	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003826	MN -90a	11:6929
DOE/PC/80521-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003641	MN -90a	11:6917
DOE/PC/81008-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001551	MN -90i	11:6919
DOE/PE/70045-2	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86003876	MN -96	11:7422
T25	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003772	MN -96	11:7423
DOE/PE/72005-T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003834	MN -11	11:7830
DOE/R0/00481-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000460	MN -97e	11:7080
DOE/R0/00542-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000449	MN -97e	11:7081
DOE/R0/00608-T1	NTIS, PC A02; 3		DE86000448	MN -60	11:7168

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DOE/R1/10000-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000393	MN -61D	11:7687
DOE/R1/10027-T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000373	MN -97e	11:7082
DOE/R1/10063-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000387	MN -97e	11:7685
DOE/R1/10392-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000339	MN -95f	11:7407
DOE/R2/05006-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000509	MN -97e	11:7083
DOE/R2/05048-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000498	MN -95d	11:7420
DOE/R9/50006-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000347	MN -13	11:7169
DOE/RA/50658-T1	NTIS, PC A12/MF A01 (GPO Dep.)	E 1.99:	DE86000203	MN -97	11:7171
DOE/RG-0066	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001000	MN -97a	11:7350
DOE/RW-0039	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004091	MN -70	11:7000
DOE/SF/01424-48-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003451	MN -92	11:6946
DOE/SF/10499-T9-Rev.	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000693	MN -62a	11:7112
DOE/SF/11997-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001702	MN -63	11:7108
DOE/SF/15799-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004170	MN -66	11:7153
DOE/SR/00952-T12	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86003907	MN -83	11:6980
DOE-tr-273-Vol.6	NTIS, PC A16; 3		DE85018282		11:7180
273-Vol.6	NTIS, PC A16; 3		DE85018282		11:7181
273-Vol.6	NTIS, PC A16; 3		DE85018282		11:7182
273-Vol.6	NTIS, PC A16; 3		DE85018282		11:7364
273-Vol.6	NTIS, PC A16; 3		DE85018282		11:7365
273-Vol.6	NTIS, PC A16; 3		DE85018282		11:7366
273-Vol.6	NTIS, PC A16; 3		DE85018128	MN -93	11:7367
DP-84-125-2	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86004081	STD -70	11:7001
1702	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86004080	STD -11	11:7002
1703	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004082	STD -11	11:7003
DP-MS-85-32	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000560	MN -38	11:7626
85-54	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003144	MN -70	11:7004
85-56	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003143	MN -70	11:7005
85-63	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001966	MN -15	11:7230
85-65	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003948	MN -70	11:7509
85-66	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003147	MN -4	11:7565
85-127	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003142	MN -37	11:7773
85-134	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003935	MN -47	11:6979
85-139	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003146	MN -38	11:7627
85-142	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003141	MN -37	11:7774
DPST-85-731	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003951	MN -70	11:7006
EEB-W-85-06	*See* LBL-19383	E 1.99:	DE85014541	MN -94a	11:7394
EGG-2423	*See* NUREG/CR-4429		TI86003737	MN -78	11:7293
10282-1083	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004176	STD -41	11:7825
10282-2083	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003028	MN -38	11:7775
EGG-EA-6906	NTIS, PC A02/MF A01 - GPO		TI86003211	MN -78	11:7190
7004	NTIS, PC A02/MF A01		TI86003254	MN -78	11:7256
EGG/EOS-Vol.2-NNE-L1-5-Rev.1	NTIS, PC A07/MF A01 - GPO (GPO Dep.)	E 1.99:	TI85016657	MN -78	11:7242
EGG-M-04985	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004106	MN -48	11:7752
09385	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003230	MN -38	11:7669
10085	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003217	MN -11	11:7674
11985	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003245	MN -25	11:7445
17284	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85016155	MN -80	11:7222
20985	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003220	MN -78	11:7257
22585	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003219	MN -66a	11:7151
23485	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003224	MN -78	11:7258
26385	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003218	MN -38	11:7446
27385	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003226	MN -78	11:7259
EGG-MS-6958	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002306	MN -78	11:7776
EGG-PBS-7002	NTIS, PC A04/MF A01 - GPO		TI86003258	MN -78	11:7232
EGG-RST-7025	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003213	MN -80	11:7260

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EGG-WM-6916	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003250	MN -70	11:7040
EIR-558	NTIS (US Sales Only), PC A03/MF A01; 1		DE86750722	MN -13	11:7326
EPA-560/ 6-84-004	*See* ORNL-6094	E 1.99:	DE86003507	MN -48	11:7872
EPRI-AP-4253-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920056	ND -90d	11:6904
4291	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920057	ND -90f	11:6942
4335	NTIS, PC A07/MF A01; 1 - Research Reports Center, Box 50490, Palo Alto, CA 94303 (GPO Dep.)	E 1.99:	DE86003367	MN -60	11:7170
4344	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920059	ND -90c	11:6905
4345	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920055	ND -90d	11:6906
EPRI-CS-4252-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920064	ND -90	11:7173
4252-Vol.4	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920066	ND -90	11:7174
4252-Vol.5	Research Reports Center, Box 50490, Palo Alto, Ca 94303		TI86920067	ND -90	11:7175
EPRI-EA-4305-Vol.1	Research Reports Center, Box 50490, Palo Alto, Ca 94303		TI86920070	ND -11	11:7809
4305-Vol.2	Research Reports Center, Box 50490, Palo Alto, Ca 94303		TI86920071	ND -11	11:7810
4314	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920068	ND -97b	11:7351
4347	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920073	ND -97	11:7352
EPRI-EL-4202	NTIS, PC A12/MF A01; 1 - Research Reports Center, Box 50490, Palo Alto, CA 94303 (GPO Dep.)	E 1.99:	DE86000060	MN -97	11:7172
4333	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920060	ND -97d	11:7176
EPRI/EL/EM-4290-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920048	ND -97	11:7184
EPRI-EM-4332	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920062	ND -97d	11:7373
EPRI-NP-2511-CCM-Vol.1-Rev.2	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303		TI85016258	ND -80	11:7309
4157	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI85920783	ND -78	11:7262
4327	Research Reports Center, Box 50490, Palo Alto, Ca 94303		TI86920049	ND -85	11:6983
ERDA-021	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018242	MN -83	11:7210
ESL-152	*See* DOE/ID/12079-125	E 1.99:	DE86002010	MN -66a	11:7140
161	*See* DOE/ID/12079-126	E 1.99:	DE86002012	MN -66a	11:7141
EUR-8299	Commission of the European Communities, Luxembourg			ND -66a	11:7145
8999	Commission of the European Communities, Luxembourg			ND -59A	11:7115
9010	Commission of the European Communities, Luxembourg			ND -95d	11:7408
9039	Commission of the European Communities, Luxembourg				11:7109
9164	Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg				11:7823
9177	Commission of the European Communities, Luxembourg				11:7327
9259	Commission of the European Communities, Luxembourg			ND -59A	11:7094
9290	Commission of the European Communities, Luxembourg				11:8047
9305	Commission of the European Communities, Luxembourg			ND -59A	11:7116
9313-Vols.1,2	Commission of the European Communities, Luxembourg				11:7061
9324	Commission of the European Communities, Luxembourg			ND -66b	11:7146
9333	Commission of the European Communities, Luxembourg			ND -66b	11:7147

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9377	Commission of the European Communities, Luxembourg				11:7811
9378	Commission of the European Communities, Luxembourg				11:7812
9382	Commission of the European Communities, Luxembourg				11:6907
9414	Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg				11:7110
9443	Commission of the European Communities, Luxembourg				11:7328
9712-EN-IT	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -95d	11:7389
9726-EN/ DE	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -95d	11:7390
9727-EN/ DE	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -95d	11:7391
9774-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -59A	11:7117
9791-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -59A	11:7118
9841-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -63	11:7100
9843-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -63	11:7101
9847-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -62	11:7131
9851-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -95d	11:7392
9852-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -94a	11:7134
9905-EN/ IT	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -59A	11:7686
9911-FR/ EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -59A	11:7119
9957-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -63	11:7111
10171-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -11	11:7801
FNAL/C-					
85/ 134-A	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002994	MN -34B	11:7890
85/ 150	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003033	MN -28	11:7753
85/ 156	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003030	MN -28	11:7754
FNAL-TM-					
1200	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003551	STD -28	11:7777
1358	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002549	STD -28	11:7755
1359	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002544	STD -32	11:7707
1363	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003546	STD -28	11:7756
FOA-C-					
20537-T1	*See* N-85-11495				11:7797
54055-H1	*See* N-85-11533				11:7860
FRNC-TH-					
2065	NTIS (US Sales Only), PC A09/MF A01; 1		DE86750306	MN -38	11:7778
FTD-ID(RS)T-					
1548-84	*See* AD-A-155261/1/XAB				11:7617
GA-A-					
14212	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003777	MN -77	11:7263
GAT-					
1127	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003177	MN -41	11:7051
GAT-T-					
3372	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003752	MN -4	11:7396
GEND-					
053	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003799	STD -70	11:7510
GKSS-					
85/ E/ 16	NTIS (US Sales Only), PC A03/MF A01		DE86900298	MN -25	11:7670
85/ E/ 18	NTIS (US Sales Only), PC A02/MF A01		DE86900299	MN -11	11:7813
HEDL-					
7553	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85018506	MN -79	11:7447
7559	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003267	MN -41	11:8044

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
HEDL-SA-					
3278	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85018468	MN -78	11:7231
3323-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018501	MN -79	11:7238
3333-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85018474	MN -79g	11:7239
3353	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86004016	MN -80	11:7448
IFP-					
32-898	NTIS (US Sales Only), PC A07/MF A01; 1		DE86750291	MN -11	11:7878
IOS-Rep-					
204	NTIS (US Sales Only), PC A15/MF A01		DE86700210	MN -70	11:7007
IS-T-					
1194	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002117	MN -34A	11:7912
JINR-					
E-1-84-442	NTIS (US Sales Only), PC A02/MF A01		DE85703256	MN -34D	11:7951
E-2-84-809	NTIS (US Sales Only), PC A02/MF A01		DE85703186	MN -34D	11:7963
E-2-84-842	NTIS (US Sales Only), PC A02/MF A01		DE85703204	MN -34D	11:7981
E-2-85-82	NTIS (US Sales Only), PC A02/MF A01		DE85703205	MN -34D	11:7982
E-11-84-495	NTIS (US Sales Only), PC A02/MF A01		DE85703203	MN -34D	11:7983
Juel-Spez-					
297	NTIS (US Sales Only), PC A14/MF A01; 1		DE86750490	MN -94a	11:7317
K-					
124	*See* DOE/OT/21400-T3	E 1.99:	DE86003597	MN -34A	11:7593
203	*See* DOE/OT/21400-T9	E 1.99:	DE86003595	MN -34C	11:8025
366	*See* DOE/OT/21400-T10	E 1.99:	DE86003594	MN -4	11:7564
419	*See* DOE/OT/21400-T11	E 1.99:	DE86003593	MN -4	11:7595
1019-Rev.4	*See* DOE/OT/21400-T7	E 1.99:	DE86003599	MN -22	11:7050
1103	*See* DOE/OT/21400-T12	E 1.99:	DE86003585	MN -4	11:7575
K/CSD/TM-					
58	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86004397	MN -95c	11:7393
K-L-					
2052	*See* DOE/OT/21400-T4	E 1.99:	DE86003601	MN -22	11:7563
K/OA-					
5968	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004009	MN -22	11:6975
K/OP-					
219	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003587	MN -86	11:7202
276	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86003589	MN -98F	11:7338
K-TL-					
107	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003590	MN -25	11:7566
612	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003591	MN -22	11:6976
K-Trans-					
53	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003592	MN -22	11:6978
LA-					
9003-MS	*See* NUREG/CR-2319		TI86000178	MN -77	11:7281
10282-MS	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86004376	STD -13	11:7330
10426-MS	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86004365	STD -41	11:7873
10465-PR	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003291	STD -80	11:7218
10466-MS	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003286	STD -38	11:7677
10470-M	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003294	STD -15	11:7757
10479-MS	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003281	STD -70	11:7008
10487-MS	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004360	STD -59B	11:7127
10515-MS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001231	STD -97c	11:7353
10522-MS	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004367	STD -32	11:8153
10546-PR	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004368	STD -11	11:7819
10548-MS	*See* NUREG/CR-3646		TI86003232	MN -78	11:7283
10549-M	*See* NUREG/CR-4396		TI86003266	MN -79p	11:7219
10558-HDR	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86004383	STD -66b	11:7148
10566-MS	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004378	STD -34	11:7795
LA-tr-					
85-16-Rev.	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003563	MN -34A	11:7936
85-50	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002859	MN -11	11:7885
85-54	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002861	MN -38	11:7616
LA-UR-					
85-2943	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002393	MN -38	11:7628
85-3166	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000782	MN -34	11:7644
85-3212	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002392	MN -34A	11:8059
85-3245	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86000767	MN -34A	11:7919
85-3315	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000822	MN -34B	11:7891
85-3471	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002391	MN -38	11:7645
85-3518	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002390	MN -21	11:8154
85-3524	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002387	MN -34C	11:7964
85-3544	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002385	MN -37	11:7758
85-3546	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002384	MN -34	11:8060
85-3560	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002404	MN -38	11:7646
85-3568	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002403	MN -48	11:7863
85-3569	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002402	MN -34	11:8049
85-3571	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002401	MN -34A	11:7920
85-3579	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002400	MN -28	11:7708
85-3580	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002399	MN -28	11:7747
85-3582	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002397	MN -28	11:7748
85-3597	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002420	MN -32	11:8155
85-3634	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002415	MN -48	11:7849
85-3664	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002412	MN -34C	11:8017
85-3676	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86002409	MN -34B	11:7908
85-3729	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002444	MN -66	11:7142
85-3734	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002443	MN -38	11:7647

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85-3735	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002442	MN -15	11:7057
85-3785	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003689	MN -38	11:7648
85-3803	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002435	MN -38	11:7771
85-3825	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001698	MN -34C	11:8003
85-3834	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002430	MN -38	11:7612
85-3846	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002429	MN -34A	11:7921
85-3850	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002428	MN -20d	11:8101
85-3851	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002427	MN -21	11:8102
85-3854	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002426	MN -38	11:7649
85-3855	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002425	MN -21	11:8103
85-3864	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002422	MN -38	11:7650
85-3902	NTIS, PC A02/MF A01 - GPO		TI86003687	MN -78	11:7266
85-3957	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003682	MN -38	11:7629
85-4034	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003665	MN -38	11:7630
85-4071	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003656	MN -38	11:7651
LAPETH-					
26	NTIS (US Sales Only), PC A06/MF A01; 1		DE86750723	MN -11	11:7802
LBL-					
19214	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002890	MN -25	11:7449
19233	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002865	MN -25	11:7450
19383	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85014541	MN -94a	11:7394
19425	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003995	MN -25	11:7489
19640	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003996	MN -41	11:7779
19665	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003992	MN -37	11:7759
19808	NTIS, PC A03; 3		DE86002867	MN -28	11:7749
19828	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002877	MN -25	11:7451
19922	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001991	MN -38	11:7631
19939	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002866	MN -38	11:7652
19947	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002891	MN -25	11:7452
20022-Vol.1	*See* NUREG/CR-4355-Vol.1		TI86001210	MN -41	11:7858
20053	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86002966	MN -48	11:7871
20084	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86000601	MN -32	11:8156
20089	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003993	MN -34A	11:8061
20109	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004018	MN -4	11:7600
20184	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002874	MN -25	11:7511
20218	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001984	MN -25	11:7453
20260	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002886	MN -34D	11:7974
20276	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004001	MN -34	11:7937
20295	NTIS, PC A09/MF A01 (GPO Dep.)	E 1.99:	DE86002895	MN -34A	11:7922
20300	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002887	MN -34C	11:8026
20326	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002878	MN -25	11:7454
20328	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004007	MN -25	11:7512
20344	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002888	MN -34B	11:7892
20354	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004008	MN -25	11:8050
20412	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002880	MN -34D	11:7984
20463	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003989	MN -34D	11:7952
LMF-					
112	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004188	STD -48	11:7857
LSU/CES-					
85-W-03	NTIS, PC A04/MF A01; 1		DE86900267	MN -98B	11:6951
MDC-G-					
8555-Rev.	*See* DOE/SF/10499-T9-Rev.	E 1.99:	DE86000693	MN -62a	11:7112
ME-					
79-002	*See* DOE/R1/10027-T1	E 1.99:	DE86000373	MN -97e	11:7082
MLM-					
3312(OP)	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003448	MN -25	11:7789
3316(OP)	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003733	MN -23	11:7058
3319(OP)	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003729	MN -4	11:7604
3320(OP)	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003731	MN -25	11:7455
N-					
84-22727	NTIS, PC A02/MF A01				11:7609
84-23746	Issuing Activity				11:7456
84-23751	NTIS, PC A06/MF A01				11:7457
84-23805	NTIS, PC A03/MF A01				11:7780
85-10378	NTIS, PC A18/MF A01				11:8157
85-11495	NTIS, PC A05/MF A01				11:7797
85-11533	NTIS, PC A04/MF A01				11:7860
85-26994/ 2/ XAB	NTIS, PC A05/MF A01				11:7490
NAK-					
5	NTIS (US Sales Only), PC A06/MF A01		DE86700212	MN -70	11:7052
9	NTIS (US Sales Only), PC A03/MF A01		DE86700213	MN -70	11:7053
14	NTIS (US Sales Only), PC A03/MF A01		DE86700211	MN -70	11:7054
NASA-CR-					
174961	*See* DOE/NASA-0290-1	E 1.99:	DE86003906	STD -96	11:7425
NEDO-OS-					
8404	NTIS (US Sales Only), PC A12/MF A01; 1		DE86900211	MN -90	11:6908
8406	NTIS (US Sales Only), PC A07/MF A01; 1		DE86900213	MN -66	11:7149
8506	NTIS (US Sales Only), PC A08/MF A01; 1		DE86900214	MN -66	11:7150
NLR-MP-					
84053-U	Nationaal Lucht- en Ruimtevaartlaboratorium, P.O. Box 90502, 1006 BM Amsterdam, Netherlands			ND -93	11:7363
NMAB-					
429-1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003171	MN -95f	11:7416

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NP-					
6770043	NTIS (US Sales Only), PC A08/MF A01; 1		DE86770043	MN -97e	11:7084
6770044	NTIS (US Sales Only), PC A11; 3		DE86770044	MN -59A	11:7417
6770045	NTIS (US Sales Only), PC A06/MF A01; 1		DE86770045	MN -97a	11:7178
6770046	NTIS (US Sales Only), PC A05/MF A01; 1		DE86770046	MN -98E	11:7421
6770047	NTIS (US Sales Only), PC A10/MF A01; 1		DE86770047	MN -88	11:6921
6770048	NTIS (US Sales Only), PC A04/MF A01; 1		DE86770048	MN -59B	11:7128
6770049	NTIS (US Sales Only), PC A07/MF A01; 1		DE86770049	MN -11	11:7834
6770050	NTIS (US Sales Only), PC A10/MF A01; 1		DE86770050	MN -11	11:7835
6770051	NTIS (US Sales Only), PC A04/MF A01; 1		DE86770051	MN -95d	11:7395
6770052	NTIS (US Sales Only), PC A03/MF A01; 1		DE86770052	MN -13	11:7339
6770053	NTIS (US Sales Only), PC A06/MF A01; 1		DE86770053	MN -13	11:7354
6770054	NTIS (US Sales Only), PC A15/MF A01; 1		DE86770054	MN -95d	11:7396
6900283	NTIS (US Sales Only), PC A09/MF A01;1		DE86900283	MN -2	11:7709
NRC-					
003	*See* NRC-5902170		TI85902170	MN -83	11:7334
5902169	NTIS, PC A03/MF A01 - GPO		TI85902169	MN -83	11:7211
5902170	NTIS, PC A02/MF A01 - GPO		TI85902170	MN -83	11:7334
NUREG-					
0750-Vol.12-No.3	NTIS, PC A03/MF A01 - GPO		TI86900076	MN -80	11:7205
0750-Vol.21-Index2	NTIS, PC A06/MF A01 - GPO		TI86900127	MN -80	11:7206
0750-Vol.22-No.3	NTIS, PC A09/MF A01 - GPO		TI86900336	MN -80	11:7207
0824-Suppl.1	NTIS, PC A04/MF A01 - GPO		TI86900362	MN -41	11:7267
0989-Suppl.4	NTIS, PC A03/MF A01 - GPO		TI86900081	MN -78	11:7268
0989-Suppl.5	NTIS, PC A04/MF A01 - GPO		TI86900331	MN -41	11:7269
NUREG/CP-					
0017	NTIS, PC A07/MF A01 - GPO		TI86000945	MN -80	11:7270
0018	NTIS, PC A04/MF A01 - GPO		TI86000944	MN -80	11:7271
0071	NTIS, PC A13/MF A01 - GPO		TI86900128	MN -78	11:7272
NUREG/CR-					
0602	NTIS, PC A18/MF A01 - GPO $10.00		TI86000896	MN -15	11:7567
0986	NTIS, PC A07/MF A01 - GPO		TI86000099	MN -70	11:7009
1100	NTIS, PC A07/MF A01 - GPO		TI86000154	MN -78	11:7233
1289	NTIS, PC A13/MF A01 - GPO		TI86002720	MN -70B	11:7041
1402	NTIS, PC A05/MF A01 - GPO		TI86002769	MN -80	11:7273
1624-Vol.1	NTIS, PC A04/MF A01 - GPO		TI85016671	MN -78	11:7274
1624-Vol.4	NTIS, PC A02/MF A01 - GPO		TI86002760	MN -80	11:7275
1821	NTIS, PC A08/MF A01 - GPO		TI85015927	MN -78	11:7276
1862	NTIS, PC A07/MF A01 - GPO		TI86002685	MN -70B	11:7042
1864-Vol.1	NTIS, PC A08/MF A01 - GPO		TI85015900	MN -78	11:7277
1940	NTIS, PC A07/MF A01 - GPO		TI85016012	MN -78	11:7278
1953	NTIS, PC A06/MF A01 - GPO		TI85016010	MN -78	11:7279
2000-Vol.4-No.10	NTIS, PC A06/MF A01 - GPO		TI86003825	MN -80	11:7191
2015-Vol.1	NTIS, PC A04/MF A01 - GPO		TI85015977	MN -78	11:7280
2319	NTIS, PC A04/MF A01 - GPO		TI86000178	MN -77	11:7281
2343	NTIS, PC A08/MF A01 - GPO		TI86004154	MN -70	11:7010
2417	NTIS, PC A03/MF A01 - GPO		TI86000119	MN -80	11:7282
3646	NTIS, PC A10/MF A01 - GPO		TI86003232	MN -78	11:7283
3887	NTIS, PC A10/MF A01; 1 - GPO		TI86002574	MN -78	11:7284
3914	NTIS, PC A03/MF A01 - GPO		TI86002070	MN -80	11:7285
3998-Vol.3	NTIS, PC A04/MF A01 - GPO		TI86002992	MN -78	11:7286
4104	NTIS, PC A05/MF A01 - GPO		TI85018127	MN -80	11:7212
4110	NTIS, PC A17/MF A01 - GPO		TI86003566	MN -70	11:7011
4133	NTIS, PC A06/MF A01 - GPO		TI86900344	MN -80	11:7287
4146	NTIS, PC A05/MF A01 - GPO		TI86001633	MN -80	11:7223
4209	NTIS PC E04/MF A01 - GPO		TI86003552	MN -78	11:7288
4350/ 5	NTIS, PC A10/MF A01 - GPO		TI86003269	MN -41	11:7289
4355-Vol.1	NTIS, PC A05/MF A01 - GPO		TI86001210	MN -41	11:7858
4360-Vol.1	NTIS, PC A07/MF A01 - GPO		TI86002977	MN -80	11:7234
4385	NTIS, PC A05/MF A01 - GPO		TI86003761	MN -78	11:7290
4396	NTIS, PC A07/MF A01 - GPO		TI86003266	MN -79p	11:7219
4399	NTIS, PC A06/MF A01 - GPO		TI86003775	MN -78	11:7291
4402-Vol.1	NTIS, PC A02/MF A01 - GPO		TI86001938	MN -77	11:7292
4429	NTIS, PC A05/MF A01 - GPO		TI86003737	MN -78	11:7293
NUREG/TR-					
0027	NTIS, PC A03/MF A01 - GPO		TI86900077	MN -80	11:7294
NVO-					
294	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002149	MN -11	11:7879
NZERDC-					
113	NTIS (US Sales Only), PC A02/MF A01; 1		DE86900270	MN -96	11:7426
OLS-					
85-15-Vol.6	*See* DOE-tr-273-Vol.6		DE85018128	MN -93	11:7367
OR-					
80-027	*See* DOE/R0/00542-T1	E 1.99:	DE86000449	MN -97e	11:7081
ORNL-					
6094	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003507	MN -48	11:7872
6153	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001429	STD -10	11:8142
ORNL/ENG/TM-					
31/ V1	*See* NUREG/CR-4360-Vol.1		TI86002977	MN -80	11:7234
ORNL/M-					
104	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003711	MN -95d	11:7397
105	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003039	MN -95	11:7398
108	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004011	MN -38	11:7678

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
ORNL/NSIC-					
200-Vol.4-No.10	*See* NUREG/CR-2000-Vol.4-No.10		TI86003825	MN -80	11:7191
ORNL/NUREG/TM-					
361	*See* NUREG/CR-1100		TI86000154	MN -78	11:7233
431	*See* NUREG/CR-1940		TI85016012	MN -78	11:7278
ORNL/TM-					
9266	*See* NUREG/CR-3887		TI86002574	MN -78	11:7284
9329	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003005	MN -96	11:7402
9503	*See* NUREG/CR-4104		TI85018127	MN -80	11:7212
9707	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002557	MN -48	11:7852
9771	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002554	STD -79d	11:7012
9798/ Vol.1	*See* NUREG/CR-4402-Vol.1		TI86001938	MN -77	11:7292
9870	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003556	MN -80	11:7240
ORO-					
3346-263	*See* DOE/ER/03346-263	E 1.99:	DE86001895	MN -34C	11:8015
5135-80/ 1	*See* DOE/ET/20372-T1	E 1.99:	DE86002176	MN -60	11:7167
PATENTS-US-	(US: Commissioner of Patents, Washington, D.C. 20231, USA, $1.00 per copy. Government Patent Applications available from NTIS)				
4,452,755					11:7226
4,515,173					11:7791
4,515,750					11:7224
4,516,020					11:7785
4,516,028					11:7786
4,534,709					11:7639
4,535,026					11:7531
4,535,250					11:6984
PB-					
85-205920	NTIS				11:7501
PPC/CP-					
85-8	*See* DOE/ET/51013-163	E 1.99:	DE86003357	MN -20b	11:8100
85-9	*See* DOE/ET/51013-162	E 1.99:	DE86003363	MN -20	11:8071
PINSTECH-					
104	NTIS (US Sales Only), PC A02/MF A01		DE86700187	MN -37	11:8027
PINSTECH/NPD-					
112(FNPG)	NTIS (US Sales Only), PC A02/MF A01		DE86700186	MN -37	11:7760
PNL-					
3297	*See* NUREG/CR-0986		TI86000099	MN -70	11:7009
5372	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85015232	MN -95	11:7665
5382	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004234	MN -95a	11:7399
5408	NTIS, PC A10/MF A01 (GPO Dep.)	E 1.99:	DE86002296	MN -11	11:7838
5491	NTIS, PC A08/MF A01 (GPO Dep.)	E 1.99:	DE86003793	MN -70	11:7013
5543	*See* NUREG/CR-4385		TI86003761	MN -78	11:7290
5556	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE86003938	MN -90d	11:6909
5557	*See* NUREG/CR-4399		TI86003775	MN -78	11:7291
5577-1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003795	MN -70	11:7513
5577-8	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003801	MN -70	11:7014
5581	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003838	MN -70	11:7015
5604	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86003545	MN -70	11:7016
5609	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86003185	MN -70	11:7043
5632	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE86003959	MN -70	11:7017
5633	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003155	MN -41	11:7839
5654	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE86003800	MN -70	11:7514
5657	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003542	MN -70	11:7018
5676	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86003958	MN -95	11:7375
PNL-SA-					
9612	NTIS, PC A02/MF A01 - GPO		TI85016705	MN -78	11:7295
12814	NTIS, PC A02/MF A01 - GPO		TI85017897	MN -78	11:7296
13035	NTIS, PC A02/MF A01 - GPO		TI85018526	MN -78	11:7192
13061	NTIS, PC A03/MF A01 - GPO		TI85016610	MN -80	11:7297
13082A	NTIS, PC A02/MF A01 - GPO (GPO Dep.)	E 1.99:	TI85016270	MN -78	11:7193
13178	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003558	MN -90i	11:6944
13237	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001768	MN -11	11:7814
13252	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004021	MN -32	11:8158
13264	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002816	MN -38	11:7632
13354	NTIS, PC A02/MF A01 - GPO		TI85018528	MN -51	11:7044
13359	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004027	MN -41	11:7815
13446	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001772	MN -37	11:7781
13475	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004029	MN -70	11:7019
13489	NTIS, PC A02/MF A01 - GPO		TI86002055	MN -78	11:7194
13505	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004030	MN -41	11:7298
128195	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85016271	MN -78	11:7195
PNL-tr-					
452	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001605	MN -46	11:7220
PR-					
79-010	*See* DOE/R2/05006-T1	E 1.99:	DE86000509	MN -97e	11:7083
PSI-					
385/ TR-528	*See* DOE/MC/21385-1928	E 1.99:	DE85016904	STD -90c	11:6893
PUR-					
17	NTIS, PC A03/MF A01; 1		DE85901837	MN -95f	11:7337
REG/G-					
3.4	US Nuclear Regulatory Commission, Washington, DC 20555		TI85901687	MN -16	11:7633

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
3-52-Rev.1	US Nuclear Regulatory Commission, Washington, DC 20555		TI85016196	MN -2	11:7055
RFP-					
2016	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004075	MN -10	11:7020
3777	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001262	MN -11	11:7820
3884	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86001564	MN -38	11:7634
RHO-RE-EV-					
78-L	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004019	MN -70	11:7021
SAI-MLM-					
2585	*See* NUREG/CR-0602		TI86000896	MN -15	11:7567
SAN-					
0499-61-Rev.	*See* DOE/SF/10499-T9-Rev.	E 1.99:	DE86000693	MN -62a	11:7112
SAND-					
81-1663	*See* NUREG/CR-2343		TI86004154	MN -70	11:7010
82-8773	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003567	MN -4	11:7610
83-2166	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003440	MN -51	11:6973
83-7011	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004172	MN -70	11:7022
84-1451	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017595	MN -70	11:7023
84-1545	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86003444	MN -38	11:7671
84-2668	*See* NUREG/CR-4110		TI86003566	MN -70	11:7011
84-7207	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86003445	MN -70	11:7024
84-8929	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002840	MN -62a	11:7132
85-0205	*See* NUREG/CR-4146		TI86001633	MN -80	11:7223
85-0213	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004173	MN -70	11:7884
85-0315	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85014341	MN -32	11:8159
85-0559C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003242	MN -70	11:7025
85-0679	*See* NUREG/CR-4209		TI86003552	MN -78	11:7288
85-0749	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004226	MN -13	11:8139
85-0958	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86004225	MN -38	11:7635
85-1077	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86004230	MN -13	11:7679
85-1096	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003966	MN -13	11:7796
85-1177C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003500	MN -25	11:7515
85-1266C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003235	MN -20a	11:8104
85-1301C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002588	MN -38	11:7613
85-1331	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE86004235	MN -92	11:6956
85-1333C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003568	MN -25	11:7516
85-1348C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003726	MN -25	11:7517
85-1349C	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86002589	MN -25	11:7518
85-1427	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86004231	MN -25	11:7458
85-1445	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003839	MN -70	11:7026
85-1495/ 5	*See* NUREG/CR-4350/5		TI86003269	MN -41	11:7289
85-1598C	NTIS, PC A02; 3		DE86003714	MN -25	11:7519
85-1636C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003715	MN -25	11:8051
85-1741	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003797	MN -21	11:8105
85-1761	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86004227	MN -25	11:7680
85-1848C	NTIS, PC A02/MF A01 - GPO		TI86002122	MN -78	11:7299
85-1961C	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002916	MN -25	11:7459
85-2026C	NTIS, PC A02/MF A01 - GPO		TI86001753	MN -78	11:7300
85-2035	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86003189	MN -32	11:8160
85-2037	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE86003791	MN -32	11:8161
85-2084C	NTIS, PC A02/MF A01 - GPO		TI86002127	MN -78	11:7301
85-2093	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003792	MN -11	11:7798
85-2104C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003173	MN -25	11:7520
85-2156C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003496	MN -25	11:7521
85-2297	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003796	MN -32	11:8162
85-2371C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002919	MN -28	11:7712
85-2384C	NTIS, PC A03; 3		DE86002922	MN -25	11:7460
85-2396C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003240	MN -92a	11:6961
85-2397C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003239	MN -92a	11:6962
85-2398C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003241	MN -92a	11:6958
85-2399C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003236	MN -92a	11:6963
85-2400C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003237	MN -92a	11:6964
85-2401C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003238	MN -92a	11:6965
85-2442C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003495	MN -25	11:7491
85-2584C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003725	MN -25	11:7492
85-2607C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003713	MN -25	11:7502
85-2619C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003723	MN -25	11:7461
SERI/SP-					
271-2589	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99:	DE85008791	MN -58	11:7102
SKB-KBS-TR-					
84-09	NTIS (US Sales Only), PC A07/MF A01		DE86700214	MN -70	11:7027
84-10	NTIS (US Sales Only), PC A03/MF A01		DE86700215	MN -70	11:7028
84-11	NTIS (US Sales Only), PC A10/MF A01		DE86700216	MN -70	11:7029
84-12	NTIS (US Sales Only), PC A02/MF A01		DE86700217	MN -70	11:7045
84-14	NTIS (US Sales Only), PC A03/MF A01		DE86700218	MN -70	11:7030
84-15	NTIS (US Sales Only), PC A03/MF A01		DE86700206	MN -70	11:7605
84-17	NTIS (US Sales Only), PC A11/MF A01		DE86700219	MN -70	11:7046
SLAC-					
287	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003794	STD -34D	11:7953
SLAC-PUB-					
3763	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001458	MN -34D	11:7965
3777	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002938	MN -28	11:7761
3787	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002941	MN -34C	11:8035
3790	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002942	MN -28	11:7762

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
3791	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003863	MN -05	11:7340
3793	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003860	MN -38	11:7614
3794	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002936	MN -34D	11:7985
3795	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002935	MN -34D	11:7966
3811	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002944	MN -28	11:7763
3815	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002158	MN -34D	11:7954
SREL-					
18	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003902	MN -11	11:7841
SSI-					
85-04	NTIS (US Sales Only), PC A02/MF A01		DE86700226	MN -2	11:7302
STEV-FBA-					
85-8	NTIS (US Sales Only), PC A02/MF A01		DE86700220	MN -70	11:7821
85-9	NTIS (US Sales Only), PC A02/MF A01		DE86700221	MN -70	11:7822
STMPO-					
214-Rev.	*See* DOE/SF/10499-T9-Rev.	E 1.99:	DE86000693	MN -62a	11:7112
STUDSVIK-NW-					
83-443	*See* NAK-5		DE86700212	MN -70	11:7052
84-701	*See* NAK-9		DE86700213	MN -70	11:7053
84-768	*See* SKB-KBS-TR-84-12		DE86700217	MN -70	11:7045
85-929	*See* NAK-14		DE86700211	MN -70	11:7054
TFBP-TR-					
262	NTIS, PC A03/MF A01 - GPO		TI85016659	MN -78	11:7303
TVA/PE/NP-					
85/ 14	NTIS, PC A02/MF A01; 1		DE86900230	MN -78	11:7225
TVA/PE/OPS-					
84/ 6	NTIS, PC A02/MF A01		DE85901742	MN -97	11:7355
UCID-					
18574-84-4	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002901	MN -25	11:7428
18674-Vol.1	*See* NUREG/CR-1624-Vol.1		TI85016671	MN -78	11:7274
18674-Vol.4	*See* NUREG/CR-1624-Vol.4		TI86002760	MN -80	11:7275
19765	NTIS, PC A17/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003523	MN -25	11:7503
20015	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE85017142	MN -80	11:7189
20080-Rev.1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004180	MN -38	11:7636
20348	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002858	MN -38	11:7615
20445	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003903	MN -2	11:8143
20509	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99:	DE86003960	MN -70	11:7462
20552	NTIS, PC A10/MF A01 (GPO Dep.)	E 1.99:	DE86003537	MN -38	11:7688
20555	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002960	MN -32	11:8163
20585	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86003498	MN -28	11:7697
20590	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003904	MN -2	11:8144
20597	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004181	MN -25	11:7463
UCLA/PPG-					
875	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003204	STD -20f	11:8072
UCRL-					
15675	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002597	MN -37	11:7522
15725	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002614	MN -48	11:7865
15730	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003487	MN -11	11:7880
53014	*See* NUREG/CR-1821		TI85015927	MN -78	11:7276
53021-Vol.1	*See* NUREG/CR-2015-Vol.1		TI85015977	MN -78	11:7280
53643	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003443	STD -38	11:7637
53686	NTIS, PC A12/MF A01 (GPO Dep.)	E 1.99:	DE86004184	MN -34A	11:8052
84181	NTIS, PC A02/MF A01 - GPO		TI85016686	MN -78	11:7304
84182	NTIS, PC A02/MF A01 - GPO		TI85016685	MN -78	11:7305
84186	NTIS, PC A02/MF A01 - GPO		TI85016681	MN -78	11:7306
84187	NTIS, PC A02/MF A01 - GPO		TI85016680	MN -78	11:7307
90427	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002626	MN -10	11:7464
90712	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002625	MN -34C	11:7923
90792	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002619	MN -34C	11:8020
90805	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002601	MN -38	11:7653
90938	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002621	MN -21	11:8106
90983	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86002193	MN -38	11:7681
91956	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001651	MN -28	11:7698
92369	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86003488	MN -48	11:7866
92482	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86001907	MN -41	11:7816
92528	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002965	MN -20b	11:8107
92558	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86003195	MN -21	11:8108
92623	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002376	MN -20b	11:8109
92676-Rev.1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86002375	MN -13	11:8145
92700-Rev.1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86002171	MN -20d	11:8110
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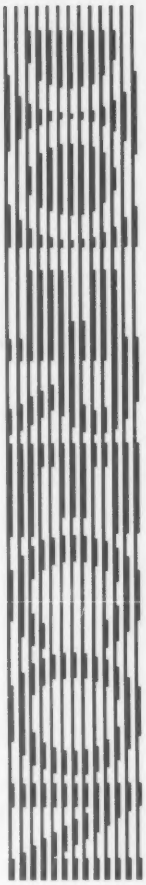

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